

**Public health impact and implications of the use of anabolic androgenic steroids (AAS) and associated drugs amongst the male general population.**

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A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

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## Acknowledgements

With sincere thanks to all the academics who have influenced and shaped my understanding of the research population and methodologies required to investigate this fascinating and complex topic. Pat Lenehan and Mark Bellis warrant specific mention, both informed and challenged my views. There are many others who have guided and influenced my work in this field but they are too many to mention here. This education has not been limited to academia, in fact, none of the research would have been possible without the trust of the AAS using communities and in particular, patience shown to me by influential individuals within these groups.

I am grateful to Prof Claire Stewart for acting as initial internal reviewer and providing helpful guidance and to my examiners Dr Ian Davies, Prof Sue Backhouse and Dr Ornella Corazza for their challenging and stimulating viva, ultimately, strengthening the thesis. Prof Marie Claire van Hout, in her role as supervisor, has been invaluable in her guidance and encouragement. I am also grateful to Liverpool John Moores University for the opportunity to pursue a PhD by published work.

Finally, a massive thank you to my wife Claire Vila and my children Chloe and Katie for their love, support and inspiration, without which this thesis would not have been possible.

## Abstract

Anabolic androgenic steroids (AAS) and associated drug use is now recognised as a significant concern and an emerging public health issue. Once restricted to the elite sporting arena, recent decades have seen AAS diffuse through bodybuilding and gym culture to an increasingly image conscious general population. This portfolio of research contributes to our understanding of this phenomenon in relation to our understanding of the extent and characteristics of AAS use, emerging harms and the policy response to the issue, as summarised below.

While specific prevalence is unknown, data from needle and syringe programmes (NSPs) indicate growing numbers of people who inject AAS and associated drugs. Often portrayed in the media as a homogenous group of young male, working class men, a growing body of research indicates a much more diverse population in relation to demographic characteristics and motivations for use. Further research indicates that this is by no means confined to the United Kingdom (UK) but is a global public health issue although barely recognised in some countries such as the Republic of Ireland.

Changes in the specific drugs of use and the regimes employed have been identified, with a growing pharmacopeia of easily accessible and affordable peptide hormones being used as a direct result of the rise of the Internet, coupled with developments in manufacturing and transportation. Opinion, anecdote and targeted marketing on the Internet fill the void of a lack of empirical evidence in the field of AAS, image and performance enhancing drugs (I PEDs) influencing a trend towards higher dosages, multiple drugs and prolonged use. Drug use is not confined to I PEDs, with psychoactive drug use identified in populations in UK and Internationally.

Our understanding of the chronic health harms associated with AAS has increased over the last 25 years, in particular cardiovascular damage, psychological harms and the potential for dependence. However, this research has made a significant contribution to the recognition and understanding of the harms associated with the administration of these drugs through injection and the impact of adulterated products as a result of the illicit market. The extent

of localised infection and soft tissue injury is a cause for concern, an issue previously neglected. Of further concern is the prevalence of blood borne virus (BBV) infection within the population of AAS users. In the first studies of their kind, HIV amongst AAS injectors has been shown to be at a similar level as that in psychoactive drug injectors in the UK. Hepatitis B and hepatitis C levels were identified as being higher than in the general population, and of key concern is the low levels of awareness of hepatitis C positive status amongst AAS injectors.

The UK has operated a comprehensive NSP system since the 1980s, which has seen increasing numbers of AAS injectors however, there remains barriers to engagement with this population of people who inject drugs. Data from interviews and surveys submitted here identify a level of mistrust and lack of confidence among AAS users when it comes to engaging with health professionals.

The following thesis, submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy spans over twenty years of academic work within the specific field of AAS use. The research provides the groundwork for the development of meaningful and successful policies and interventions to reduce harm and promote health based on the need of this population. The submission includes a brief critical reflection on the undertaken research and the engagement with the research population, drawing on my experiences, positionality and evolution of knowledge and understanding. This further informs the concluding remarks and suggestions for future research.

The key contribution of the following portfolio of work can be summarised as follows:

## **Summary of contribution to evidence and understanding of AAS use**

### **Changes in extent, characteristics and practices of AAS users**

- Significant increases in the number of AAS injectors engaging with NSP across UK.
- Health service gap for AAS users who do not inject
- Diffusion of use from central urban post-industrial cities to suburban and rural areas.
- Increased numbers of older AAS users due to cohort effect and later onset of use.
- More diverse motivations for use, typology of user and risk profile.
- High levels of psychoactive drug use amongst AAS users.
- Population of AAS users who have previously injected psychoactive drugs.
- Increasing prevalence of human growth hormone.
- Increased use of new peptide hormones including melanotan, MGF and GHRP-6.
- Re-emergence of DNP amongst AAS users and its diffusion to the wider population.
- Increased dosages, longer cycles and the introduction of “blast & cruise” regimens.

### **Evidence of harm related to the use of AAS and associated drugs**

- Confirmation of established harms through systematic review
- Significant number of HIV positive users of AAS in the United Kingdom.
- Hepatitis B and hepatitis C infection amongst AAS users.
- Low levels of hepatitis c testing and diagnosis amongst AAS using population.
- Psychoactive drug use, sex between men and imprisonment predictive of infection.
- Sharing of injecting equipment amongst sub-populations of AAS users.
- High levels of unprotected sex amongst AAS users.
- Common localised infection such as abscess formation and soft tissue injury.
- Adulteration and substitution of active ingredients resulting in harm.
- Wide variation in strength of illicitly manufactured AAS and associated drugs.
- Adulteration of supplements with AAS and associated drugs.
- The ease of availability and low understanding of risks associated with DNP.

### **The health and drug policy response to the emerging public health issue**

- NSPs in UK engaged with large numbers of AAS injectors.
- Wide variation in NSP service uptake and engagement across the UK.
- Little evidence of effectiveness of engagement strategies with AAS users.
- Mistrust of academics and health service amongst many AAS users.
- Reluctance of AAS users to declare use or seek treatment for harms.
- Blood borne virus testing and vaccination remains low amongst AAS users.
- Inadequate response to AAS use in Ireland.
- Potential for greater engagement of AAS users via sexual health services.
- Recognition of AAS use within UK clinical guidelines and drugs policy.
- Legislation changes have not impacted on prevalence of AAS use.
- Negative unintended health consequences of legislation.

# Public health impact and implications of the use of anabolic androgenic steroids (AAS) and associated drugs amongst the male general population.

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## Appendix I: Submitted Papers

- 1) 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
- 2) **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
- 3) Zahnow, R., **McVeigh, J.**, Ferris, J., & Winstock, A. (2017). Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users. *Contemporary Drug Problems* 44(1):69-83 01
- 4) **McVeigh, J.**, Germain, J., & Van Hout, M. C. (2016). 2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness. *Journal of Substance Use*, 22(2), 131-138.
- 5) **McVeigh, J.**, Hearne, E., Bates, G., & Van Hout, M. C. (2016). Community pharmacist experiences of providing needle and syringe programmes in Ireland. *Research in Social and Administrative Pharmacy*. S1551-7411(16)30310-2
- 6) Kimergard, A., & **McVeigh, J.** (2014). Environments, risk and health harms: a qualitative investigation into the illicit use of anabolic steroids among people using harm reduction services in the UK. *BMJ Open*, 4(6), 7 pages. doi:10.1136/bmjopen-2014-005275
- 7) Hope, V. D., **McVeigh, J.**, Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., Croxford S., Beynon C. M., Parry J. V., Bellis, M. 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),
- 8) **McVeigh, J.**, Beynon, C., & Bellis, M. A. (2003). New challenges for agency based syringe exchange schemes: Analysis of 11 years of data (1991-2001) in Merseyside and Cheshire, United Kingdom. *International Journal of Drug Policy*, 14(5-6), 399-405.

## Appendix II: Supplemental material

Appendix II.1 Supplemental peer-reviewed journal papers

Appendix II.2 Additional peer-reviewed journal papers, editorials, systematic reviews

Appendix II.3 Selected minor peer reviewed papers, reports and book chapters

Appendix II.4 Examples of plenary and keynote conference presentations (Last 12 months)

## Section 1: Portfolio of work

### 1.1 Peer-reviewed articles submitted for PhD with contribution to submitted work

1) 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

Journal Impact Factor 3.48 Citations – 4 Altmetric 9

Contribution: Second author responsible for conception of study, co- development of methodology and 40% writing of paper.

2) **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

doi:10.1080/09687637.2016.1245713.

Journal Impact Factor 0.94\* Citations – 13 Altmetric 104

\* selected as a top published paper over the last 25 years

Contribution: Principle author responsible for conception of study, development of methodology analysis and writing of paper.

3) Zahnow, R., **McVeigh, J.**, Ferris, J., & Winstock, A. (2017). Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users.

*Contemporary Drug Problems* 44(1):69-83 01 doi:10.1002/dta.1728

Journal Impact Factor 0.59 Citations – 5 Altmetric - 1

Contribution: Second author responsible for conception of study, co- development of methodology, co-analysis and 40% writing of paper.



4) **McVeigh, J.**, Germain, J., & Van Hout, M. C. (2016). 2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness. *Journal of Substance Use*, 22(2), 131-138. doi:10.3109/14659891.2016.1149238

Journal Impact Factor 0.77 Citations - 3 Altmetric 5

Contribution: Principle author responsible for conception of study, development of methodology analysis and analysis and writing of paper.

5) **McVeigh, J.**, Hearne, E., Bates, G., & Van Hout, M. C. (2016). Community pharmacist experiences of providing needle and syringe programmes in Ireland. *Research in Social and Administrative Pharmacy*. S1551-7411(16)30310-2 doi:10.1016/j.sapharm.2016.07.006

Journal Impact Factor 2.20 Citations - Altmetric 8

Contribution: Principle author responsible for conception of study, development of methodology analysis and analysis and writing of paper.

6) Kimergard, A., & **McVeigh, J.** (2014). Environments, risk and health harms: a qualitative investigation into the illicit use of anabolic steroids among people using harm reduction services in the UK. *BMJ Open*, 4(6), 7 pages. doi:10.1136/bmjopen-2014-005275

Journal Impact Factor 2.37 Citations 13 Altmetric - 15

Contribution: Second author responsible for conception of study, co-development of methodology, co-analysis and 45% writing of paper.

7) Hope, V. D., **McVeigh, J.**, Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., Croxford S., Beynon C. M., Parry J. V., Bellis, M. 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), 11 pages. doi:10.1136/bmjopen-2013-003207

Journal Impact Factor 2.37 Citations – 43 Altmetric - 49

Contribution: Second author responsible for co-conception of study, co-development of methodology and 35% writing of paper.

8) **McVeigh, J.**, Beynon, C., & Bellis, M. A. (2003). New challenges for agency based syringe exchange schemes: Analysis of 11 years of data (1991-2001) in Merseyside and Cheshire, United Kingdom. *International Journal of Drug Policy*, 14(5-6), 399-405. doi:10.1016/S0955-3959(03)00141-5

Journal Impact Factor 3.47 Citations – 29 Altmetric -

Contribution: Principle author responsible for conception of study, development of methodology, co-analysis and writing of paper.

Total citations of the 8 submitted publications : 110

All Journal Impact Factors, Citations and Altmetrics scores are accurate as of 14<sup>th</sup> February 2018 (Symplectic, 2018).

## Section 2: Introduction

### 2.1 Introduction to thesis

The following introduction (2.2) provides context to the thesis ***'Public health impact and implications of the use of anabolic androgenic steroids (AAS) and associated drugs amongst the male general population'***. It provides a brief historical perspective, leading to the point of commencement of the research submitted for this thesis. It is required in order to evidence the significant contribution of the submitted research and how the portfolio of work has changed our understanding of the phenomenon. The review draws on both scientific literature in the form of peer-reviewed journal papers and academic books and importantly, includes literature produced by those who are part of the AAS using community. The 'underground literature' has had a significant impact on drug use practices and risk behaviour often filling the void of inadequate academic evidence. Therefore, to gain a thorough understanding of the issues associated with the use of AAS, it is essential that the work of cultural innovators such as Dan Duchaine, William Phillips and William Llewellyn (Phillips, 1991, Llewellyn and Tober, 2010, Duchaine, 1989, Llewellyn, 2017) <sup>1</sup> are viewed alongside the academic outputs of the leading academics such as Pope and Yesalis (Pope and Kanayama, 2012, Pope and Katz, 1992, Pope et al., 2016, Pope et al., 2000, Yesalis, 1992, Yesalis and Bahrke, 2002, Yesalis et al., 1989).

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<sup>1</sup> Bill Phillips and to an even greater extent Dan Duchaine were the most influential icons of the anabolic steroid using communities in the United States and United Kingdom during the 1980s and 1990s. While largely based on experience and local observation, their publications were used as manuals of use and their views rarely questioned. Bill Llewellyn has been highly influential over the last 20 years, with a web presence, media exposure and popular publications, his outputs are extensively researched, referenced and accessible to the AAS user community.

The focus of the research and following thesis is the use of AAS and associated drugs by men. The use of these drugs is by no means restricted to men, literature over time and across geographical areas have all indicated that use does occur amongst women, albeit at significantly lower levels (Sagoe et al., 2014c, Bahrke et al., 1998, Buckley, 1988, Hakansson et al., 2012, Broadfield, 2017). While there is limited research on the use of these drugs by women, the literature indicates significant differences to their male counterparts in relation, to motivations and drivers, practices and effects (Ip et al., 2010, Gruber and Pope, 1999, Strauss et al., 1985, Malarkey et al., 1991, Gerritsma et al., 1994). Early research conducted with colleagues (Korkia et al., 1996) provided clear evidence that while there exists commonality amongst both male and female AAS users, the female specific issues are such that they warrant a separate approach, analysis and commentary, beyond the scope of this thesis.

The introduction also aims to provide the rationale for the content of the submitted research. Namely, to inform our understanding of three major issues in relation to the public health impact and implications of AAS and associated drug use amongst the general population; i) the extent, characteristics and practices of users; ii) harm related to use; iii) the policy response to this emerging public health issue. These three issues correspond to sections four to six of the thesis, where the results of the submitted research papers are discussed. Prior to the three results sections, section three examines the methodology, limitations and theoretical approach to the research portfolio.

Sections four to six continue from the point of completion of the following introduction and have a strong focus on the UK. The exception to this is section six, examining the policy

response to anabolic androgenic steroid use, in particular, that by health services. In doing so, it includes findings from two studies submitted as part of this thesis. One drawing on analysis from the Global Drug Survey (Paper 3), the other exploring needle and syringe provision in Ireland (Paper 5), a country at the early stages of AAS service development.

Section seven: provides a brief summary to the thesis together with implications for future policy and research.

## 2.2 Introduction to AAS and associated drug use amongst the general population

Pharmacologically active agents, usually referred to as drugs, are administered or self-administered for a number of different purposes and with various motivations. While the self-administration of illicitly obtained drugs is often portrayed and perceived as a hedonistic pursuit of pleasure, this is not always the case. Rather than the instant gratification, euphoria or stimulation produced by a drug, the purpose may be predominantly functional, taken in an attempt to improve or enhance an individual's abilities or appearance (Juengst, 2000, McVeigh et al., 2012a, Savulescu et al., 2011). This is the focus of my portfolio of work, which examines the use of functional enhancement drugs over the last 20 years, in particular AAS use in the UK and within a global context.

Human enhancement drugs and their usage is by no means a new phenomenon, with records of its use in social, ritual and sporting contexts throughout recorded history. Over the past thirty years there has been growing evidence related to human enhancement drugs, the associated epidemiology and the potential harms. However, it is only in the last

decade that human enhancement drugs have been formally categorised into distinct groups, based on their function rather than pharmacological properties. These comprise six general classes; structure and function of muscle; weight loss; cosmetic; appearance of the skin and hair; sexual behaviour and function; cognitive function; mood and social behaviours (Evans-Brown et al., 2012, McVeigh et al., 2012a). This work has led to subsequent research and academic investigation into these diverse types of drug use under a broad term of Human Enhancement (Brennan et al., 2016, van de Ven and Koenraadt, 2017)

It is the category of drugs consumed with the intent of enhancing structure and function of muscle that is the primary focus of my research portfolio. Diverse substances consumed for the purpose of sporting performance and muscular enhancement can be found in literature dating back to ancient civilisations such as Greece and Rome. While the veracity of accounts from the earliest recorded civilisations may be questionable they reflect a common drive for muscular enhancement (both size and function) in many global and historical cultures (Taylor, 1991, Csaky, 1972).

The most prevalent, well-established and infamous group of drugs within the spectrum of human enhancement drugs are the AAS (Evans, 2004, Evans-Brown and McVeigh, 2009a, Pope et al., 1988, Pope and Katz, 1992, Kanayama et al., 2010b, Yesalis, 1992, Korkia and Stimson, 1993, Bahrke and Yesalis, 2004, Yesalis and Bahrke, 1995, Buckley, 1988).

Testosterone, required for normal functioning and health (Nieschlag and Behre, 2004, Nieschlag et al., 2004) was first isolated and synthesised 1935 (Yesalis and Bahrke, 1995, de Kruif, 1945). This resulted in the development of the related chemicals, namely anabolic

androgenic steroids (AAS) (ACMD, 2010b, Hoberman and Yesalis, 1995, de Kruif, 1945). The androgenic effects of these drugs are associated with masculinisation, essential reproductive function and the development of secondary male characteristics while the anabolic component is related to protein building in skeletal muscle and bone. (Kochakian, 1975, ACMD, 2010b, ACMD, 2010a, Kicman, 2008b). The anabolic components cannot be entirely separated, something which has been attempted since the first anabolic androgenic steroid, Dianabol, went into production in the 1950s (Fair, 1993, Taylor, 1991). While it is useful to view the effects of testosterone and therefore AAS within the simple categories of anabolic and androgenic, testosterone acts on many systems throughout the body resulting in changes in cardiovascular function, the immune system, mood and behaviour (Nieschlag et al., 2004, Kicman, 2010, Kicman et al., 2010).

From the 1950s, the use of AAS quickly spread through competitive sport, in particular those sports relying on power and strength (Kruskemper, 1968, Voy, 1991, Todd, 1987, Dubin, 1990, Wright, 1978, Dimeo, 2007) and into the aesthetic and recreational sporting domains. Whilst the media and much of society have focused predominately on the use of AAS within elite sport, the use of testosterone and AAS for wellbeing and general human enhancement has also grown in popularity.

Rooted in the practice of 'organotherapies', 'patent medicines' and 'secret remedies' of the early twentieth century (Evans-Brown et al., 2012, Hoberman, 2001, BMA, 1909), the prescription of testosterone became fashionable for a period from the 1940s in the United States (Hoberman and Yesalis, 1995). As recently as 1953, physicians in publications such as the Journal of the American Medical Association were discussing the values and relative safety of prescribing testosterone to enhance vitality and feelings of wellbeing (Hoberman,

2001). However, the advent and marketing of the new AAS from the mid 1950s resulted in increasing interest in these substances to both aid sporting performance and to enhance musculature for physique.

The use of AAS within the gym culture was well established in parts of the United States by the 1970s, having first been introduced by elite and 'avant garde' bodybuilders from the late 1950s and 1960s (Hoberman and Yesalis, 1995, Yesalis et al., 1989, Evans-Brown et al., 2012). Bodybuilding had gained significantly in popularity in the United States (Parish et al., 2010), as society, driven by mass media (Longobardi et al., 2017, Leit et al., 2002), began to equate masculinity with high levels of muscularity (Cafri et al., 2005, Cafri et al., 2006). The use of AAS within the general population in the UK appears to have arrived later than the United States and may be classed as relative 'late adopters' in comparison to the 'innovators' and 'early adopters' of the United States (Rogers, 1983, Rogers, 1995, De Tarde, 1903, Zinberg, 1984). Although the use of AAS within bodybuilding in the UK was reported in the medical literature of the 1960s (Pearson, 1967, MacQueen, 1967) it wasn't until the 1980s that widespread use within the gym culture was identified (Lenehan et al., 1996).

The 1980s saw the first prevalence studies of AAS use in the United States. Whilst individual and team case studies reported specific instances of use amongst young males as early as 1959 (Yesalis et al., 2000b), it was a landmark prevalence survey (Buckley, 1988) that set the methodology for much of the subsequent prevalence research. This study identified an AAS prevalence of 6.6% amongst 12<sup>th</sup> grade male United States students. Based on this methodology, subsequent surveys supported these findings (Komorowski, 1992, Tuttle et al., 1994, Johnson et al., 1989, DuRant et al., 1993, DuRant et al., 1995, Whitehead et al., 1992,



Luetkemeier et al., 1995, Middleman et al., 1995, Bahrke et al., 1998, Stilger and Yesalis, 1999) with prevalence estimates ranging between 3% and 12% in the United States (Yesalis et al., 2000a). By the mid-1990s, with research stimulated following the Ben Johnson scandal of 1988 (Dubin, 1990, Francis, 1990), similar adolescent prevalence studies were conducted in Canada (Melia et al., 1996), Sweden (Nilsson, 1995), with both indicating high levels of usage. Prior to 2000, few other surveys were conducted outside United States.

In the UK, to date, no such adolescent prevalence studies have been conducted, however there were a number of case reports and small-scale studies within private gymnasia (McKillop, 1987, Garner and Miles, 1985). These reports were supplemented by a number of press reports, and in particular the UK newspaper *The Times* (Evans-Brown and McVeigh, 2009a, Evans-Brown et al., 2012). By the mid-1990s, a number of studies had been published highlighting the extent of AAS use in the UK. Although mostly descriptive and based on small samples in discrete geographical locations (Williamson, 1993, Perry et al., 1992, Perry and Littlepage, 1992), two influential studies were conducted during this period, a prevalence study of those attending gymnasia across the Great Britain (Korkia, 2000, Korkia and Stimson, 1997, Korkia and Stimson, 1993) and a large scale study in the North West of England (Lenehan et al., 1996).

The work of Korkia et al. (1993) found that 6% of men and 1.4% of women were current users of AAS while the work of Lenehan et al (1996), based on 1954 gym attenders, found that 26.7% were current users of AAS. The surveys also illustrated a wide variation of prevalence dependent on the characteristics of the gym. The surveys both had additional interviews with AAS users, 110 in the national study (Korkia, 2000, Korkia and Stimson,

1997, Korkia and Stimson, 1993) and an additional 386 in the North West of England (Lenehan et al., 1996). The results gave the first robust evidence of a large population of AAS users in the UK, whose motivation for use was primarily for aesthetic purposes. Users of AAS could be placed in three broad categories, the majority of whom are male (AAS use in females appears to be predominantly limited to bodybuilders and sportswomen (Korkia et al., 1996, Lenehan et al., 1996, Korkia, 2000, Korkia and Stimson, 1997, Korkia and Stimson, 1993, Evans-Brown and McVeigh, 2009a). While users may fall within more than one group and change over time they were thought of as: 1) competitive athletes; 2) occupational users (including security, manual workers and entertainers ; and, 3) recreational users (using for aesthetic purposes) (Lenehan, 2003, Lenehan and McVeigh, 1998) with by far the largest group being the recreational users (Evans-Brown and McVeigh, 2009a).

In 1996, AAS and a range of associated drugs were controlled under the Misuse of Drugs Act (1971) as Class C (Lenehan, 2003, Lenehan and McVeigh, 1998, Evans-Brown and McVeigh, 2009a, Evans-Brown et al., 2012, ACMD, 2010b). This made them prescription only medicines therefore only lawfully sold or supplied in accordance with a prescription from an appropriate practitioner. However, it remained legal to possess or import/export AAS as long as they were intended for personal use and in the form of a medicinal product. This change in the legislation was largely based on the perceived potential for harm associated with their use (ACMD, 2010b), although this premise was disputed on the grounds of insufficient evidence, both within the academic community (Korkia, 1998a) and the lay AAS-using community (Hart, 1993)<sup>2</sup> of the UK.

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<sup>2</sup> Mick Hart was a former United Kingdom bodybuilder, gym owner, AAS user and self-styled media expert on AAS during the 1990s and 2000s.

The 1990s through to the early 2000s witnessed a growing understanding of AAS actions and effects (ACMD, 2010a, Kicman, 2008a, Kicman and Gower, 2003, Kicman et al., 2010). This included conclusive evidence for the potential enhancement and growth of skeletal muscle (Bhasin et al., 1996, Bhasin et al., 2001), until this point a disputed theory. Despite clear indications to the contrary both the British Association of Sports Medicine (BASM) and the American College of Sports Medicine (ACSM) position statements of the 1970s had denied the potential benefits of AAS (Taylor, 2001), with the former President of the ACSM, Dr A.J. Ryan was reported to have referred to them as a “fool’s gold”(Pampel, 2007). The position statement of the of ACSM included the following line, as recounted by Bob Goldman, “There is no conclusive evidence that extremely high dosages of AAS either aid or hinder athletic performance” (Goldman, 1984). These statements had remained in circulation for many years, despite cultural and ethno pharmacological knowledge to the contrary (Duchaine, 1989, Phillips, 1991, Chinery, 1993, Gallaway, 1997).

Whilst there were significant gaps in the scientific literature in relation to the epidemiology of AAS use, there was increasing knowledge and understanding of the methods and practices of use. Key sources of information were the “underground literature”, providing guides to drug regimes, including dosages, specific AAS and ancillary drugs. The influence of underground literature (predominantly from the United States) on the AAS using community could be seen in research conducted in the UK. A high level of consensus emerged amongst the UK research (Korkia and Stimson, 1993, Lenehan et al., 1996, Pates and Barry, 1996, Burton, 1996) indicating that the majority of users were taking several different AAS simultaneously, relatively low levels of other anabolic hormones (such as

human growth hormone), but a range of other drugs such as thyroxine (Dawson and Harrison, 1996) nalbuphine (McBride et al., 1996) and gammahydroxy butyrate (GHB) (Lenehan and McVeigh, 1998). Drugs such as nalbuphine and GHB could be traced back to literature by Dan Duchaine (Duchaine, 1989). Drugs used to counter the adverse effects of AAS such as tamoxifen and human chorionic gonadotrophin were also advocated by the 'steroid gurus' Duchaine (1989) and Phillips (1991) and adopted by users in the UK (Aguilera, 1999, Lenehan et al., 1996, Korkia and Stimson, 1993).

Until relatively recently, there remained significant gaps in our understanding of the harms caused by the use of AAS and associated drugs. Many of the cosmetic effects caused by hormonal imbalance (e.g. virilisation and aromatization) had been well understood and documented for some time (Wright, 1982, Kochakian, 1976). Case reports of mortality and serious morbidity were compiled by Friedle in the 1990s, including serious conditions associated with the renal system (Prat et al., 1977, Bryden et al., 1995), hepatic system (Overly et al., 1984, Creagh et al., 1988, Cabasso, 1994, Yoshida et al., 1994) and cerebro-cardiovascular system (Dickerman et al., 1995, Huie, 1994, Kennedy, 1992, Kennedy and Lawrence, 1993, Ferenchick and Adelman, 1992, Lyngberg, 1991, Luke et al., 1990, Frankle et al., 1988, Mochizuki and Richter, 1988). However, even with the ever growing list of these reports Friedle concluded that: 'Many "well established" *risks are based on anecdotal experiences and misinterpreted science*' (Friedle, 1993). This supported the earlier conclusions of Wright, a leading authority on AAS, who quoted the work of socio-biologist Garrett Hardin, stating that a side effect is simply: "any effect we don't want, the existence of which we will deny for as long as we can" (Wright, 1978). In 1982 Wright went on to say that while there is a strong case to support the view that AAS can cause significant harm,

physicians were only just recognizing the flaws in generalizing adverse effects within a clinical population to that of fit and healthy sports participants (Wright, 1982). This contributed to the tension between the medical/scientific community and the subculture of the anabolic androgenic steroid users themselves, who to a large degree were not experiencing significant morbidity or mortality associated with their AAS use (Phillips, 1991, Duchaine, 1989).

Prior to 2013, there was little evidence regarding the extent of Human Immunodeficiency Virus (HIV) infection amongst users of AAS and associated drugs. While the potential for transmission was clear (Lenehan and McVeigh, 1994), there were few specific cases identified and published (Scott and Scott, 1989, Sklarek et al., 1984, Henrion et al., 1992) and the issue gained little attention. In the UK data from surveillance of injecting drug users attending needle and syringe programmes in the 1990s identified only three cases of hepatitis B and no cases of HIV amongst a sample of 149 AAS users. This led the authors to conclude that the risk of blood borne virus transmission amongst AAS injectors was low (Crampin et al., 1998). Other research in the UK countered this with specific cases of hepatitis C infection amongst AAS injectors (Cook et al., 2000) and evidence of potential transmission amongst the community from sexual contact as well as through the specific sharing of injecting equipment (Best and Midgley, 1998, Midgley et al., 2000).

Increasing numbers of academic papers citing the psychological effects of AAS, in particular those associated with aggression were published. This association was based on theoretical and observational animal work (Bahrke et al., 1996, Bahrke et al., 1990b), together with a number of studies by Pope (Pope and Katz, 1992, Pope and Katz, 1990, Pope and Katz, 1994,

Choi and Pope, 1994). However, a range of psychological changes were compiled as early as 1984, including both positive effects such as increased alertness and focus and desire to win together with increased aggression, violence and psychosis (Taylor, 1991). During the 1990s these were confirmed by other researchers (Korkia, 1998b, Bahrke et al., 1990b, Parrott et al., 1994) and additional symptoms identified such as affective disorders (Perry and Hughes, 1992) and mania (Su et al., 1993) together with earlier cases identified and referenced, such as that of schizophrenia (Annitto and Layman, 1980). Issues related to aggression were a growing concern, particularly in the United States (Bahrke et al., 1992, Bahrke et al., 1990a, Pope and Katz, 1990, Pope and Katz, 1994). Research at this time in the UK revealed self-reports of aggression being commonplace amongst AAS users, with police officers also citing a link between AAS and serious violent crimes (Bristow, 1988). However, accounts of aggression being used instrumentally to facilitate training were also published at this time (Lenehan et al., 1996, Korkia and Stimson, 1993, Evans-Brown and McVeigh, 2009a).

In the development of evidence relating to dependence on AAS, a similar situation could be observed, with increasing literature from the United States (Brower et al., 1989, Brower et al., 1990, Brower et al., 1991a, Brower et al., 1991b, Bahrke et al., 1990b, Pope and Katz, 1992, Bahrke and Yesalis, 1994). In the UK, a range of adverse effects were described on cessation of AAS including depression (13.2%), dissatisfaction with body image (10.8%), and feelings of wanting to take more steroids (16.9%). Additionally, 3.2% of those interviewed reported suicidal thoughts on discontinuation of use (Lenehan et al., 1996, ACMD, 2010b), supporting earlier work in the United States published in 1985 (Taylor, 2001).

While an increasing number of studies into the effects (both positive and negative) of AAS and associated drugs were conducted and findings published during the 1980s and 1990s there remained many contradictions. This lack of consistency in the evidence base has been attributed to a number of factors including variations in study design and methods, use of non-validated scales, inconsistent recording of variables such as dosage, the self-reported nature of many studies and the placebo/nocebo effect of AAS (Bahrke and Yesalis, 2002). A significant additional confounding factor in relation to the illicit market has also been identified. With many available AAS being manufactured illicitly without adequate quality assurance it may be concluded that if "...the composition of the drug products cannot be assured and we do not quantify and assess the impact of this, then how can we know if we are examining the effects of a specific drug product?" (Evans-Brown et al., 2009b). Despite the caveats to the evidence base, the conclusions regarding adverse effects were (to varying degrees) supported amongst the AAS using community (Phillips, 1991, Duchaine, 1989).

The policy response to the issues related to AAS were highly variable between countries, with the major influences being sporting authorities, criminal justice agenda (including illicit drug controls) and the health agenda (including harm reduction). With regards to the policy response in the United States and the UK, they could be described as polar opposites. The UK controlled AAS under the Misuse of Drugs Act (1971) in 1996, this did not criminalize personal possession (ACMD, 2010b). The United States passed legislation in 1988, classing unlawful supply as a felony, however, prior to this, personal possession of AAS without a prescription was already classed as unlawful in all 50 states (Kleinman and Petit, 1993, Yesalis et al., 1997). So, while the United States focus was criminalisation, this was not the

case in the UK, who instead of driving AAS use further underground took a pragmatic stance to promote health and reduce harm.

Unlike the United States, the UK had adopted a harm reduction strategy in the mid-1980s, as a result of increased concerns relating to the transmission of HIV (Stimson, 1995). The policy did not only focus on the prevention of blood borne viruses but on wider interventions to reduce the health, social, and economic harms to individuals, communities, and society associated with the use of drugs. This policy saw AAS users utilizing needle and syringe programmes from the early 1990s (and earlier in some parts of the UK) (Birtles, 1998). It also aimed to facilitate the engagement of AAS users with generic health services, with some success (Dawson, 2001) (Perry et al., 1994). While the UK embraced the ethos of harm reduction, at least one physician in Australia took the step of prescribing AAS to patients for the purpose of muscular enhancement (Millar, 1996, Millar, 1998, Millar, 1994, Lenehan, 2003). While adverse effects in this instance were minimal and most patients achieved their goals without prolonged use, the experimental intervention was not widely replicated (Millar, 1996).



## Section 3: Methodology and theoretical framework

### 3.1 Methodology and limitations

A mixed methods approach has been used in this portfolio of research. The primary purpose of this work is to assess the public health impact and implications of the relatively new phenomenon of AAS and associated drug use in the general population. Therefore, a variety of methodologies have been employed:

**Paper 1** Indigenous fieldworker interviews, cluster analysis and logistic regression to identify characteristics and motivations for use (Zahnow et al., 2018).

**Paper 2** Surveillance data, historical/policy analysis to describe the growth of AAS use as a public health concern in the UK (McVeigh and Begley, 2017).

**Paper 3** Large international online survey to identify extent of service engagement within a sub population of AAS users globally (Zahnow et al., 2017).

**Paper 4** A netnographic qualitative study of knowledge, attitudes, motivations and risk taking behaviours of 2, 4-Dinitrophenol (DNP) users (McVeigh et al., 2016a).

**Paper 5** Interviews and questionnaires to identify the early indications of the emergence of AAS as a public health issue in Ireland (McVeigh et al., 2017b).

**Paper 6** Qualitative interviews to identify health risks and barriers to service engagement in the United Kingdom (Kimergard and McVeigh, 2014a).

**Paper 7** Cross-sectional bio-behavioural to identify prevalence of HIV, hepatitis B and C together with associated risk behaviours amongst AAS users (Hope et al., 2013c).

**Paper 8** Analysis of longitudinal needle and syringe programme data resulting in the identification of AAS use as a significant public health issue (McVeigh et al., 2003a).

### 3.2 Theoretical approach

Throughout the papers comprising this portfolio of work, various forms of literature from diverse disciplines have been accessed and read to inform a variety of methodologies and analytical strategies. Therefore there has not been adherence to a specific or uniform theoretical perspective or framework. However, in compiling this portfolio of work, re-examining and summarising the work and drawing conclusions as to its implications and impact, a number of theories appear relevant to different aspects of these studies. A robust theoretical grounding will be essential if the development of effective policies and interventions for users of AAS and associated drugs are to be effective and successful. The work of Tim Rhodes in relation to risk environments and psychoactive drug users is particularly pertinent to this work (Rhodes, 2009, Rhodes, 2002, Kimergard and McVeigh, 2014a). Rhodes highlights the relationship between physical, social, economic and policy factors and how it is the interplay of these factors that influence risk and the chances of harm occurring. These environmental factors have been applied to the use of AAS (Kimergard and McVeigh, 2014a) and further developed as a model to demonstrate a sociological framework for understanding AAS use (Bates et al., 2018). Similarly a socioecological framework has been proposed in relation to AAS use in sport. The ‘dopogenic’ environment (Backhouse et al., 2017) highlights the need for a ‘whole-systems approach’ , with a focus on the interactions between individuals, their social networks and the influencing structures. It is essential that the influences that dictate behaviour and risk are fully appreciated if any intervention, such as those outlined Institute of Medicine Model of prevention (from “universal” to “aftercare”) (Warner and Boat, 2009) (Backhouse et al., 2014) are to be evaluated (UNODC, 2015) and found to be effective.

While Rhodes is perhaps the key theoretical stance in relation to risk behaviours and harms, the work of Rogers and the theory of diffusion (Rogers, 1983, Rogers, 1995), contributes to our understanding of the changing epidemiology of AAS and associated drugs and is key to this portfolio of work. While by no means a new theory (De Tarde, 1903), it has adapted over time and been influenced by research into mass communication in the 1950s (Katz et al., 2017). The model features a structure by which a “*trickle down*” effect accelerates as knowledge, attitudes and behaviours are passed from a small group of innovators, to a larger group of early adopters to the (early and late) majority) and finally the “laggards”(Rogers, 1983) . In relation to drug use trends and behaviours, Zinberg’s influential contemporary work of the 1980s (Zinberg, 1984) played a part in its application to the field of substance use. The relevance of the theory of diffusion to “new” trends and patterns of drug use was illustrated Rogers’ “Diffusion of Innovation” (1983) and has been applied to inner city trends of the United States (Golub et al., 2005). The theory has also been explored and applied to the UK’s phenomenon of Novel Psychoactive Substances (NPS) (Sumnall et al., 2011), within a sophisticated online society(Corazza et al., 2017, Schifano et al., 2010) . Diffusion theory provides a useful framework for our understanding of changes in IPED use, and in particular AAS use, during recent decades. On a macro scale, the ‘innovators’ and ‘early adopters’ correspond to users in the United States, the ‘late adopters’ in the UK’ and the ‘laggards’ to the Republic of Ireland. On a Micro scale, the theory accounts for the diffusion from the city centre to the suburban and finally the rural geographical areas. The theory, in part, provides an explanation of how beliefs and behaviours can change and how the influence of a relatively small number of people (for example, (Phillips, 1991, Duchaine, 1989, Llewellyn, 2017)) can be so significant and

supports our understanding of changes in prevalence, practices and the illicit market of AAS and associated drugs.

## Section 4: Changes in extent, characteristics and practices of AAS users

### Submitted papers

**1)** 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). *Int J Drug Policy*, 55, 105-112.

**2)** **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.

**4)** **McVeigh, J.**, Germain, J., & Van Hout, M. C. (2016). 2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness. *Journal of Substance Use*, 22(2), 131-138.

**7)** Hope, V. D., **McVeigh, J.**, Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., Croxford S., Beynon C. M., Parry J. V., Bellis, M. 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), 11 pages.

**8)** **McVeigh, J.**, Beynon, C., & Bellis, M. A. (2003). New challenges for agency based syringe exchange schemes: Analysis of 11 years of data (1991-2001) in Merseyside and Cheshire, United Kingdom. *International Journal of Drug Policy*, 14(5-6), 399-405.

### Supporting evidence

Sagoe, D., **McVeigh, J.**, Bjornebekk, A., Essilfie, M. S., Andreassen, C. S., & Pallesen, S. (2015). Polypharmacy among anabolic-androgenic steroid users: a descriptive metasynthesis. *Substance Abuse Treatment Prevention and Policy*, 10, 19 pages.

Stensballe, A., **McVeigh, J.**, Breindahl, T., & Kimergard, A. (2015) Synthetic Growth Hormone releasers detected in seized drugs: New trends in the use of performance enhancement. *Addiction*, 110(2), 368-369.

Evans-Brown, M., Kimergard, A., **McVeigh, J.**, Chandler, M., & Brandt, S. D. (2014). Bodybuilding Supplements: Is the breast cancer drug tamoxifen being sold as a bodybuilding dietary supplement?. *BMJ-British Medical Journal*, 348, 2 pages.

Evans-Brown, M., **McVeigh, J.**, Perkins, C., & Bellis, M. A. (2012). Human Enhancement Drugs - The Emerging Challenges to Public Health: Human Enhancement Drugs - The Emerging Challenges to Public Health. Liverpool: Liverpool John Moores University.

Evans-Brown, M., Dawson, R. T., Chandler, M., & **McVeigh, J.** (2009). Use of melanotan I and II in the general population. *British Medical Journal*, 338.

**Aims**

To identify and quantify the changes in extent, characteristics and practices of anabolic androgenic steroid users

Contextualise the potential implications for public health related to any significant changes in the use of anabolic steroids and associated drugs.

**Contribution to evidence and understanding**

- Significant increases in the number of AAS injectors engaging with NSP services across the United Kingdom.
- Identification of significant population of AAS users who do not inject and are not engaged with any health related services.
- Diffusion of use from central urban post-industrial cities to suburban and rural areas.
- Broadening population of use including older users due to cohort effect and later onset of use.
- More diverse motivations for use, typology of user and risk profile.
- Identification of significant concurrent use of psychoactive drugs and minority of prior injection of psychoactive drugs as a United Kingdom and a global phenomenon
- Increasing prevalence of human growth hormone use amongst the AAS using population.
- Adoption of drug regimens to incorporate a range of new peptide hormones including melanotan, MGF and GHRP-6.
- Re-emergence of 2, 4-Dinitrophenol (DNP) amongst AAS users and its diffusion to the wider population
- The identification of increased dosages, longer cycles and the introduction of “blast & cruise” regimens.

As described in the introduction, there are a number of methodological barriers to ascertain an accurate estimate of the prevalence of AAS use. Historically, prevalence research in the UK has been restricted to specific populations, for example, those attending gymnasias (Korkia and Stimson, 1997, Lenehan et al., 1996) or self-identified as gay men (Bolding et al., 2002). General population surveys have been subject to the bias and limitations of household surveys (ACMD, 2010b, Evans-Brown and McVeigh, 2009a), and the examination of motivations for use, relied mainly on small samples from the 1990s (Monaghan, 2002).

The following section draws on my portfolio of work which has increased our knowledge and depth of understanding of the complexities related to AAS use. It also summarises the evidence of change in relation to drugs of use and associated practices within the populations of individuals using AAS.

#### 4.1 The extent of anabolic androgenic steroid use

While the UK Government has grown to rely on the Crime Survey for England and Wales for information relating to the prevalence of illicit drug use (Broadfield, 2017), concerns regarding its reliability have been raised (Evans-brown and McVeigh, 2008, McVeigh and Evans-brown, 2009, Chandler and McVeigh, 2014, McVeigh et al., 2012a) and broadly accepted within policy (ACMD, 2010b). The main indicator of the extent and change over time of AAS use in the UK are data collected from NSPs (ACMD, 2010b). Findings presented in the papers comprising this portfolio of research are unique in that they originate from the only longitudinal dataset of its kind, comprising intelligence from harm reduction services in Cheshire and Merseyside in the UK from 1991 (Whitfield et al., 2017, Birtles, 1998, Chandler, 2009, Chandler and McVeigh, 2014, McVeigh and Begley, 2017, McVeigh et al., 2003a). McVeigh et al. 2003, identified a significant increase in new users of AAS presenting to services ( $P < 0.001$ ) over eleven years. Between 1991 and 2006, across the same geographical area, there was a 2,000% increase in AAS using clients (Evans-Brown and McVeigh, 2009a). Further analyses in 2017 indicated a continuing trend, with a 342% increase in the number of individual AAS users accessing services in Cheshire and Merseyside and now accounting for 55% of clients (McVeigh and Begley, 2017). These analyses do not include numbers of individuals purchasing equipment online, a practice

which appears to be increasing in prevalence (McVeigh, 2017b, McVeigh, 2018a, McVeigh, 2018b, McVeigh et al., 2015a).

These data cannot distinguish between a change in prevalence of AAS use and a potential increase in the proportion of users accessing needle and syringe programmes. Equally, these do not take into account the proportion of individuals who are only using AAS orally. This remains largely unknown but data from the most recent national IPED survey indicated that over a quarter of users of AAS and associated drugs, use oral products only (Begley et al., 2017). This indicates a potentially under-researched and under-served population. However, high quality NSP data do provide a valuable indication of the extent of use, particularly in the context of many service users purporting to access equipment for their peers (McVeigh, 2007, McVeigh et al., 2003a). Even with these caveats the NSP data analysed for this portfolio of work represented a unique and major contribution to the only global epidemiological study of AAS use (Sagoe et al., 2014c). Furthermore, three UK Government reviews of AAS legislation (ACMD, 2010b) and three sets of National Institute of Health and Care Excellence (NICE) Guidelines (Bates et al., 2013, McVeigh, 2017d, NICE, 2009) were informed by these findings..

#### 4.2 Characteristics of users

It is essential that consideration is given to the groups or types of users alongside any investigation into the extent of use. As identified in the introduction, work by this author and others during the 1990s in the UK identified aspiring or recreational bodybuilders as the main group of AAS users, with the primary motivation of increasing musculature (Korkia and Stimson, 1993, Lenehan et al., 1996, Perry et al., 1992, Williamson, 1991, Burton, 1996,



Monaghan, 1999). The advent and expansion of the internet, enhanced availability of retail, transportation and communication around AAS, together with low-cost pharmaceutical manufacture in countries such as China and India, contributed to the proliferation of lifestyle or human enhancement drugs (McVeigh et al., 2012b, Evans-Brown et al., 2012). This has supported a surge in consumer interest and new markets with varied motivations for use (Begley et al., 2017, McVeigh et al., 2015a). This trend can be observed in the recent national IPED survey results, indicating that for 6.5% and 7.8% of the sample of 684 AAS users interviewed, maintaining a youthful appearance or using as a form of self-directed hormone replacement therapy, respectively, was extremely important (Begley et al., 2017). A key issue associated with these drivers is around the age of users of AAS. Much of the research around this topic has looked at young people's use, as has the policy and legislation focus (ACMD, 2010b, NICE, 2017). In contrast, research submitted as part of this portfolio does not support this premise (McVeigh and Begley, 2017). Both the mean and median age of AAS using client has increased from 26 to 31 years and 25 to 30 years respectively between 1995 and 2015. So, whilst most AAS users are aged between 20 and 29, an increasing proportion are in the older categories, in part due to older users commencing use and partly attributed to an ageing cohort effect (McVeigh and Begley, 2017).

Building on the rudimentary classifications of AAS users of the 1990s (Dawson, 2001, Lenehan and McVeigh, 1998), work was undertaken to develop a more sophisticated understanding of AAS in the 21<sup>st</sup> century (Christiansen et al., 2016). Utilising previously collected qualitative interview data and supplemented by the observations of the authors, four ideal types of users were identified based on the effectiveness of AAS use and

associated risks: the Expert type, the Well-being type, the YOLO type and the Athlete. Using the data collected for the National IPED study (Bates and McVeigh, 2016) and working with colleagues in the UK and Australia, detailed cluster analyses and logistic regression were conducted and published (Zahnow et al., 2018). Findings reflected the four categories hypothesised by Christiansen et al., (2016), Cluster 1 (comprising 11.1% of the sample) were younger and motivated by fat loss; Cluster 2 (38.6%) were concerned with getting fit; Cluster 3 (25.4%) were motivated by muscle and strength gains; Cluster 4 (24.9%) were focused on specific goals (Zahnow et al., 2018). There were several noticeable differences in finding, such as the relative size of clusters/typologies and experiences of adverse effects. This may be explained by differences in characteristics of the samples caused by the specific recruitment strategies and also by methodologies and sample sizes of the two studies, however both studies identified structures of sub groups with implications for harm reduction and wider public health.

This is little evidence related to AAS and socioeconomic group or association with deprivation. However, the rise of AAS use in the UK was first identified in the industrial, economically-challenged heartlands of the UK, in particular in the North of England (Lenehan et al., 1996, Best and Midgley, 1998) and South Wales (Korkia and Stimson, 1993, Perry et al., 1992, Perry and Littlepage, 1992). Analysis of NSP data illustrated the increasing numbers of AAS injectors presenting to Cheshire and Merseyside services in the North of England between 1991 and 2001 (McVeigh et al., 2003a). A survey of NSPs in towns and cities in North of England illustrated the preponderance of AAS users in these services (Kimergard and McVeigh, 2014c). Furthermore, this paper illustrates the diffusion of high levels of AAS use from the urban centre of Liverpool to the more affluent surrounding

suburban/rural areas over time (McVeigh and Begley, 2017), an effect previously reported within this geography for other forms of drug use (McVeigh et al., 2003b) and a well-established theory of behaviour influence and change (Rogers, 1983).

### 4.3 Changes in practice and usage

While polypharmacy is not a new phenomenon amongst AAS users in the UK (Lenehan et al., 1996, Korkia and Stimson, 1997, McBride et al., 1996, Brennan et al., 2011, Rich et al., 1998b), there are now an unprecedented array of substances used by this population. The use of human growth hormone has increased from 2.7% reported in 1993 (Korkia and Stimson, 1993) to 32% in 2013 (Hope et al., 2013c). Melanotan, an injectable melanocortin receptor agonists used as a tanning agent was unknown during the 1990s. In the mid-2000s, data from NSP in the UK indicated a small number of competitive bodybuilders injecting melanotan I and melanotan II in addition to AAS and a range of other substances (Evans-Brown et al., 2009a). By 2013, 8.6% of image and performance enhancing drug users were reporting the injection of melanotan (Hope et al., 2013c), rising to 13% in 2016 (Begley et al., 2017). Peptide hormones are now part of the repertoire of drugs used by many AAS users (Kimergard et al., 2014b) in particular growth hormone releasing hormones (Stensballe et al., 2015) including CJC 1295 (Van Hout and Hearne, 2016) and mechano growth factor (Esposito et al., 2012) alongside more established hormones such as insulin (Rich et al., 1998b) and insulin-like growth factor 1 (Begley et al., 2017). Increasingly post cycle therapy is utilised between cycles of AAS in an attempt to maintain the muscular gains, avoid reduction of libido and the lowering of mood. These effects are as a result exogenous testosterone's effect on hypothalamic–pituitary–testicular (HPT) axis, resulting in the

suppression of endogenous testosterone production (Griffiths et al., 2016). Dosages, timing, and specific testosterone stimulating drugs, including human chorionic gonadotrophic (Hope et al., 2013c) in combination with anti-oestrogens such as clomiphene and tamoxifen (McVeigh et al., 2015a) are largely due to self-experimentation “I know personally when my body requires hCG..” (Kimergard and McVeigh, 2014a) and are widely promoted as ‘responsible’ AAS usage (Sally and Tan, 2009, Llewellyn, 2017).

2,4-Dinitrophenol (DNP), is another component of the AAS users pharmacopeia, although it is not licensed for human consumption and classed as a metabolic poison (Evans-Brown et al., 2012). DNP has gained increasing media attention<sup>3</sup> and public health concern in recent years (Green et al., 2016, Hoxha and Petroczi, 2015). Although discovered 100 years ago (Koch et al., 1935, Tainter et al., 1934), its use has emerged sporadically as a potent weight loss agent (Grundlingh et al., 2011), particularly within bodybuilding cultures (Duchaine, 1989, Llewellyn, 2017). Since 2010, the use has moved from AAS users to the wider population resulting in a number of high profile fatalities. In a survey led by McVeigh in 2013, 8% of AAS users reported the use of DNP (McVeigh et al., 2015a), triggering the netnographic study submitted as part of this portfolio of work (McVeigh et al., 2016a). The study, the first of its kind to investigate this topic via online public websites, highlighted a dynamic web based market and identified the need to engage with influential website moderators to promote health messages and harm reduction amongst users and potential users of DNP (McVeigh et al., 2016a). The online methodology also contributed to the growing body of work utilizing the Kozinets’ netnographic approach (Kozinets, 2013) within

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<sup>3</sup> Particularly in newsprint in both Ireland eg Irish Times and the United Kingdom eg the Sunday Telegraph and the Daily Mail.

the field of illicit drug use including enhancement drugs (Bruneel et al., 2014, Germain et al., 2017, Loi et al., 2017, Van Hout and Hearne, 2016, McVeigh et al., 2017a).

Sagoe, McVeigh and colleagues identified an increasing array of image and performance enhancing drugs (IPEDs), and drugs used to combat side effects (Sagoe et al., 2015a, Zahnnow et al., 2017). A recent survey of IPED users identified high levels the use of analgesic products in the previous year, both prescribed (25%) and over the counter (42%) (Begley et al., 2017). Furthermore, sports and nutritional supplements are commonly used (Llewellyn, 2011) and associated with an increased propensity towards the use of illicit substances (Backhouse et al., 2013), furthermore work co-authored by McVeigh identified that adulteration of nutritional supplements with classical AAS was relatively common (Abbate et al., 2015). The cancer treatment drug tamoxifen citrate was also identified 'hidden in plain sight' as a supplement to combat gynaecomastia (Evans-Brown et al., 2014).

The Global Drug Survey, the largest drugs research project, collected data on 89,509 individuals during a three month period in 2014/15 (GDS, 2015). The survey, in 11 languages, primarily developed to recruit psychoactive drug users, in particular those using 'dance drugs' (Barratt et al., 2014, Winstock et al., 2015). However, a module of questions related to IPEDs was developed by McVeigh and introduced to the survey, resulting in data on 1,000 males reporting the use of AAS (Zahnnow et al., 2017). This sub group of AAS users resided in Europe, North America, South America, Asia, Africa and Australasia. While unable to indicate prevalence, it illustrated that AAS use amongst psychoactive drug users occurred regardless of legislation or cultural norms.

Recent work has also demonstrated the concerning levels of psychoactive drug use amongst anabolic androgenic steroid users (McVeigh et al., 2015a, Sagoe et al., 2015a), with cocaine used in the last year at 46% (Hope et al., 2013c) and lifetime prevalence of 51% (McVeigh et al., 2015a). These levels were unprecedented in the 1990s with cocaine use at 12% in the previous six months (Lenehan et al., 1996), however even at these relatively low levels they were identified as a public health concern (Lenehan and McVeigh, 1998).

Despite the difficulties in assessing dosages of drugs being used, due to the illicit nature of the market (Evans-Brown et al., 2009b), self-reported dosages of AAS are significantly higher than those used in the 1990s (Evans-Brown et al., 2012), even amongst novice users, (Chandler, 2013, McVeigh and Begley, 2017). The length of cycle (the period that drugs are used) has also increased, including one study indicating a quarter of users utilizing 'blast and cruise'. This was the first academic report of a phenomenon where the 'off cycle' is replaced with a period of lower dosage (but still in the range that is several times higher than normal endogenous production) (Chandler, 2013, McVeigh and Begley, 2017), and has implications for health and recovery.

#### 4.4 Conclusion

The published papers and supporting public health reports within my portfolio of research highlight the dynamic nature of AAS use and other associated IPEDs. We have significant evidence of increases in the numbers of AAS users in the UK (McVeigh and Begley, 2017, McVeigh et al., 2003a), changes in the demographics and types of users (Zahnow et al., 2018, Begley et al., 2017), new (Evans-Brown and McVeigh, 2009b, Evans-Brown et al., 2009a) and re-emerging drugs of use (McVeigh et al., 2016a), and changes in specific

practices (McVeigh and Begley, 2017, McVeigh et al., 2015a). All these factors contribute to the growing public health concern regarding this issues, the need for greater understanding of the phenomenon, and timely policy responses (Evans-Brown et al., 2012, McVeigh et al., 2012b).

## Section 5: Evidence of harm related to the use of AAS and associated drugs

### Submitted papers

**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.

Zahnow, R., **McVeigh, J.**, Ferris, J., & Winstock, A. (2017). Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users. *Contemporary Drug Problems* 44(1):69-83 01

Kimergard, A., & **McVeigh, J.** (2014). Environments, risk and health harms: a qualitative investigation into the illicit use of anabolic steroids among people using harm reduction services in the UK. *BMJ Open*, 4(6), 7 pages.

Hope, V. D., **McVeigh, J.**, Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., Croxford S., Beynon C. M., Parry J. V., Bellis, M. 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), 11 pages.

### Supporting evidence

Hope, VD, **McVeigh, J** Smith, J. Glass, R, Njoroge, J, Tanner, C, Parry, JV, Ncube, F, Desai M (2017) Low levels of hepatitis C diagnosis and testing uptake among people who inject image and performance enhancing drugs in England and Wales, 2012-15 *Drug and Alcohol Dependence* Volume 179, Pages 83–86

Evans-Brown, M., **McVeigh, J.**, Perkins, C., & Bellis, M. A. (2012). *Human Enhancement Drugs - The Emerging Challenges to Public Health: Human Enhancement Drugs - The Emerging Challenges to Public Health*. Liverpool: Centre for Public Health, Liverpool John Moores University.

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 Performance Enhancing Drugs in England and Wales: Results From Cross-Sectional Prevalence Surveys, 1992-2013. *JAIDS-Journal of Acquired Immune Deficiency Syndrome*, 71(3), 331-337.

Breindahl, T., Evans-Brown, M., Hindersson, P., **McVeigh, J.**, Bellis, M., Stensballe, A., & Kimergard, A. (2015). Identification and characterization by LC-UV-MS/MS of melanotan II skin-tanning products sold illegally on the Internet. *Drug Testing and Analysis*, 7(2), 164-172.



**Aims**

To identify the potential extent of previously unrecognised or under recognised health risks associated with the use of anabolic androgenic steroids and associated drugs.

**Contribution to evidence and understanding**

- Confirmation of established harms through systematic review.
- The first identification and confirmation of a significant number of HIV positive users of AAS in the United Kingdom.
- Hepatitis B and hepatitis C prevalence significantly higher amongst AAS users than the general population.
- Low levels of hepatitis c testing and diagnosis amongst AAS using population.
- Identification of risk and predictive factors for blood borne virus infection amongst AAS users, including previous psychoactive drug use, sex between men and imprisonment.
- High blood borne virus transmission risk behaviours amongst some populations of AAS users, including sharing of injecting equipment and high levels of unprotected sex.
- Significant levels of localised infection such as abscess formation and soft tissue injury.
- Specific cases relating to unexpected adverse effects of drugs due to adulteration and substitution of active pharmaceutical ingredients.
- The extent of variation in strength of illicitly manufactured AAS and associated drugs.
- The extent of hidden AAS and associated drugs within supplements purchased online and in high street shops.
- The ease of availability and low levels of knowledge related to high risk substances such as 2,4-Dinitrophenol (DNP).

As described in the introduction (Section 2), by the conclusion of the twentieth century, the scientific and medical community had a comprehensive understanding of the pharmacological and physiological mechanisms which may contribute to adverse consequences for the AAS user (Kopera, 1993, Kicman, 2008a). However, the harms associated with the use of these substances are far from limited to their pharmacological effects.

The contribution of research submitted for this portfolio of work can best be described within the categories of blood borne viruses (BBV) and injecting injuries, adulterated and contaminated products and drugs used in combination with AAS.

### 5.1 Established adverse effects of AAS.

Recent years have seen the publication of the most comprehensive overview of adverse effects by the Endocrine Society (Pope et al., 2014b). The Scientific Statement categorises the types of harms, such as chronic and acute (Strauss et al., 1985) physical harms (Friedle, 1993) psychological harm (Bahrke et al., 1996) and dependence (Brower et al., 1991a, Brower, 2002). One of the main areas of increased understanding of these adverse effects are in relation 'anabolic androgenic steroid induced hypogonadism' (Tan and Scally, 2009, Kanayama et al., 2015), particularly in those with sustained use (McVeigh et al., 2015a, Jones et al., 2011) and in the longer term cardiovascular risks have become the main area of investigation (Baggish et al., 2017, Baggish et al., 2010). However, an area of increasing recognition and concern is in relation to the effects of AAS on the brain. There is emerging evidence suggesting that prolonged AAS use is associated with cognitive impairments including memory visuospatial abilities (Heffernan et al., 2015, Grogan et al., 2006, Kanayama et al., 2013, Kaufman et al., 2015). These impairments have been explained by changes in the structure and connectivity of the brain (Bjornebekk et al., 2017, Westlye et al., 2017).

### 5.2 Adverse effects associated with injecting behaviours

### 5.2.1 HIV, hepatitis B and hepatitis C

The issue of BBV transmission and injecting injuries remained largely unrecognised amongst academics or within the AAS user communities in the United States (Yesalis et al., 1993, Phillips, 1991, Duchaine, 1989). In the UK, reliable UK data were sparse, with only a small published surveillance study of 149 AAS injectors indicating the presence of hepatitis B core antigen in 2% of the sample and no evidence of HIV (Crampin et al., 1998). A small number of academics and practitioners in the UK, continued to highlight the potential transmission of BBV amongst this population as a public health concern (Dawson, 2001, Morrison, 1994, Lenehan and McVeigh, 1994, Best and Midgley, 1998, Midgley et al., 2000). The public health issue regarding the transmission of BBV was also disputed between academics in Australia (Iversen et al., 2013, Day et al., 2008). However, it wasn't until the publication of the first large-scale cross-sectional study of BBV transmission in 2013, that the extent of the public health issue was recognised (Hope et al., 2013c). This ground breaking paper was the first to identify that the prevalence of HIV amongst injectors of AAS (and other IPEDs was similar to that of injectors of psychoactive drugs (Bates et al., 2017b, Iversen et al., 2016, Kean, 2014, McVeigh, 2017d, McVeigh and Begley, 2017, McVeigh et al., 2015a).

Furthermore, prevalence of hepatitis B and hepatitis C were identified as public health concerns with hepatitis C at ten times that found in the general population (Hope et al., 2017). Whilst individual cases of viral hepatitis were identified amongst injectors of AAS (Rich et al., 1998a, Crampin et al., 1998), the work of Hope, McVeigh and colleagues was the first to quantify the prevalence of infection within this population. These findings have had a significant impact on UK policy and guidelines issued by Public Health England Department of Health and the National Institute for Health and Care Excellence (NICE) (PHE, 2014, Department of Health, 2017, NICE, 2017). Further analysis illustrated that HIV had been

present within this population for some time and was increasing, with needle sharing, although lower than in those injecting psychoactive drugs (Larance et al., 2008, Hope et al., 2013c, Delalande et al., 1998, HPA et al., 2012) and low uptake of condoms considered to be key factors (Hope et al., 2016). Further issues such as increased libido caused by AAS, concomitant use of cocaine and sildenafil (and associated drugs that may increase libido) and higher levels of AAS use amongst men who have sex with men have all been highlighted as areas of concern regarding the prevention of BBV transmission (Bates et al., 2017b, Evans-Brown and McVeigh, 2009a, McVeigh and Begley, 2017, McVeigh et al., 2012a). Previous injection of a psychoactive drug and incarceration in prison have also been identified as predictive factors of BBV infection (Hope et al., 2013c, McVeigh, 2017c, McVeigh, 2018a)

### 5.2.2 Injection site injuries and infections

Evidence related to localised infections and other problems associated with injecting are largely restricted to individual case reports (Larance et al., 2008, Dickinson and Rich, 1996, Rich et al., 1999a, Rich et al., 1999b, Aitken et al., 2002, Delalande et al., 1998, Driscoll et al., 2011). While levels of injuries and infections amongst people who inject psychoactive drugs was well established (HPA et al., 2012), this was not the case for those injecting AAS and associated drugs (Evans-Brown et al., 2012, McVeigh et al., 2012a). Furthermore, while a growing number of case reports linked to the injection of AAS have been published, few cases related to other image and performance enhancing drugs have been identified or reported (Brennan et al., 2016, Bates et al., 2013, Hope et al., 2013c, Evans-Brown et al., 2012, McVeigh, 2018b, McVeigh et al., 2012a). Research by McVeigh and colleagues resulted in levels of local infection and injury being identified and reported in 2014,

indicating a further emerging public health issue amongst this population (Hope et al., 2010, Hope et al., 2015). Nearly half (42%) of the sample of the 366 male users of AAS reporting redness, swelling and tenderness following injection of AAS or other IPEDs and over a third (36%) in the previous year. Levels of infection were lower than that observed amongst people who inject psychoactive drugs, the 7% reporting an abscess or open wound (in some cases multiple episodes) constitutes a significant health impact and potential burden on healthcare. Furthermore, this sample comprised male IPED injectors engaged with NSPs, those who are not in contact with services may be engaging in a myriad of risk behaviours and experiencing harms at much higher levels.

### 5.3 Harms associated with adulterated and contaminated AAS and associated drugs

Counterfeit and adulterated pharmaceuticals are not restricted to AAS and other IPEDs but are a global public health concern (Fernandez et al., 2011, Tomic et al., 2010, Bonati, 2009, Pang, 2008, Cole et al., 2011, Evans-Brown et al., 2012)

The issue of adulterated AAS (a term comprising fake, contaminated, counterfeit and unlicensed products) is a long standing issue affecting user groups (Duchaine, 1989), identified as a concern amongst academics and the AAS community (Coomber et al., 2014, Cordaro et al., 2011, McVeigh and Lenehan, 1994, Perry, 1995, Abbate et al., 2015, Lenehan and McVeigh, 1998, McVeigh, 1996, Kimergard and McVeigh, 2014a, Graham et al., 2009, Musshoff et al., 1997, Grunding and Bachmann, 1995, Llewellyn and Tober, 2010, Cohen et al., 2007). In 2009, McVeigh and colleagues published a summary of the health implications of adulterated AAS and also highlighted the confounding effect of the issue on the

identification of the health harms of these drugs (Evans-Brown et al., 2009b). This led to a series of studies, both reactive, in an attempt to identify the cause of adverse events or concerns (Evans-Brown et al., 2014, Kimergard et al., 2014a, Kimergard et al., 2014b, Stensballe et al., 2015) and in sampling to ascertain the prevalence and extent of adulteration within the market (Abbate et al., 2015, Breindahl et al., 2015). The public health implications of this issue are a direct result of the illicit market with the majority of products being manufactured outside any regulation or quality assurance (McVeigh and Begley, 2017, ACMD, 2010b). The danger of accidental substitution and the potential for harm was illustrated in an investigation into adverse effects reported by a bodybuilder who had been injecting what was purported to be the anabolic hormone GHRP-6. Following complaints of nausea, skin pigmentation and several other unexpected effects, the product was analysed with colleagues in Norway and Denmark and identified as melanotan II, an injectable tanning hormone (Kimergard et al., 2014a, Kimergard et al., 2014b).

In a study of investigating the content and public health implications of the use of melanotan II, 73 specimens were purchased from three online retailers. Samples were all under strength, varying from 4mg to 9mg with some products containing up to 6% of unknown impurities (Breindahl et al., 2015). A total 24 samples of bodybuilding supplements were purchased from two fitness shops in Merseyside and three online retailers. Half of the products were identified as containing anabolic steroids controlled under the Misuse of Drugs Act (1971), at varying dosages (Abbate et al., 2015). This highlights the difficulties in attributing causality to individual drugs and even in the identification of control groups for research involving users of AAS (Evans-Brown et al., 2009b, McVeigh and Begley, 2017).

2,4-Dinitrophenol (DNP), a potent weight loss product is not licensed for human consumption and is therefore not subject to any medicines control (Evans-Brown et al., 2012). Online research illustrated the levels of risk associated with this toxic substance and how a lack of any quality assurance and administration literature can exacerbate such hazards (McVeigh et al., 2016a). The paper identified many online conversations focused on the unparalleled weight losses experienced through the use of DNP, with some discussions also featuring concerns regarding the potential for harm via uncontrolled hyperthermia. However, a common belief centred on an ability to limit the dangers through careful dosage:

“Many people think this drug is very dangerous. . . and it is. . .if misused. . . basically, there is no upper-limit to how high your body-temperature can go on this stuff. . . which means your dosage really has to be watched closely.”

However, even ‘experienced’ users appeared oblivious to the impossible task of managing a dosage of a toxic substance of unknown strength.

#### 5.4 Conclusion

In recent years, significant progress has been made in identifying serious, chronic adverse effects associated with AAS, in particular those associated with the heart (Baggish et al., 2017, Thiblin et al., 2015) and brain (Seitz et al., 2017, Westlye et al., 2017, Bjornebekk et al., 2017), together with a better understanding of the psychological impact of this form of drug use (Griffiths et al., 2018, Kanayama et al., 2018). However, research within this portfolio of work has made a significant contribution to our understanding of harms related to routes of administration of AAS and associated drugs, together with factors associated with the illicit market. Research by McVeigh and colleagues at Liverpool John Moores

University and other Institutions has identified a significant public health threat in relation to BBV (Hope et al., 2016, Hope et al., 2013c), in particular HIV (Bates et al., 2017b) and hepatitis C (Hope et al., 2017), as well as localised infections and soft tissue damage (Hope et al., 2015). In addition to written academic outputs, conferences targeting policy makers, practitioners and members of the AAS user communities have been an important vehicle for disseminating information relating to harms and risks both in the UK (McVeigh, 2017b, McVeigh, 2017e, McVeigh, 2018a) and internationally (McVeigh, 2017a, McVeigh, 2017c).



## Section six: The health and drug policy response to the emerging public health issue.

### Submitted papers

**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.

Zahnow, R., **McVeigh, J.**, Ferris, J., & Winstock, A. (2017). Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users. *Contemporary Drug Problems* 44(1):69-83 01

Kimergard, A., & **McVeigh, J.** (2014). Environments, risk and health harms: a qualitative investigation into the illicit use of anabolic steroids among people using harm reduction services in the UK. *BMJ Open*, 4(6), 7 pages.

**McVeigh, J.**, Hearne, E., Bates, G., & Van Hout, M. C. (2016). Community pharmacist experiences of providing needle and syringe programmes in Ireland. *Research in Social and Administrative Pharmacy*. S1551-7411(16)30310-2

**McVeigh, J.**, Beynon, C., & Bellis, M. A. (2003). New challenges for agency based syringe exchange schemes: Analysis of 11 years of data (1991-2001) in Merseyside and Cheshire, United Kingdom. *International Journal of Drug Policy*, 14(5-6), 399-405.

### Supporting evidence

Kimergard, A., & **McVeigh, J.** (2014). Variability and dilemmas in harm reduction for anabolic steroid users in the UK: a multi-area interview study. *Harm reduction Journal*, 11, 13 pages

Bates, G., Jones, L., & **McVeigh, J.** (2013). Update of NICE Guidance PH18 on 'Needle and Syringe programmes. PIEDs Review. Centre for Public Health, Liverpool John Moores University.

Jones, L., Pickering, L., Sumnall, H., **McVeigh, J.**, & Bellis, M. A. (2010). Optimal provision of needle and syringe programmes for injecting drug users: A systematic review. *International Journal of Drug Policy*, 21(5), 335-342.

Evans-Brown, M., **McVeigh, J.** Anabolic steroid use in the general population of the United Kingdom In *Elite Sport, Doping and Public Health*. Editors: Dimeo P, McNamee M, Moller V . (2009) 75-97 (22 pages). Univ Pr of Southern Denmark.

Jones, L., Pickering, L., Sumnall, H., **McVeigh, J.**, & Bellis, M. (2008). A review of the effectiveness and cost-effectiveness of needle and syringe programmes for injecting drug users.

**Aims**

To identify the policy and practice response to the use of anabolic androgenic steroid use and associated drugs.

To highlight the impact of policy, gaps in service provision and implications for public health.

**Contribution to evidence and understanding.**

- The United Kingdom's extensive provision of needle and syringe programmes (NSPs) has changed significantly since the 1990s and is now engaged with large numbers of AAS injectors.
- Policy and guidance related to optimal NSP service provision has been late and often poorly adhered to resulting in differences in service uptake and engagement across the United Kingdom.
- Systematic reviews have confirmed the lack of evidence related to effectiveness of different interventions and engagement strategies with AAS users.
- There is significant mistrust of academics and health service providers amongst populations of AAS users.
- Low levels of generic health service uptake to treat harms associated with AAS use in the United Kingdom and globally.
- Blood borne virus testing and vaccination remains low amongst AAS users.
- A failure to recognise the extent and implications of emerging AAS use in Ireland is a significant public health concern.
- Missed opportunity to effectively engage with populations of AAS through sexual health services.
- Increasing health policy awareness of implications of AAS use in United Kingdom clinical guidelines.
- Changes in United Kingdom legislation have not reduced prevalence of use and have had negative unintended health consequences on the illicit market.

## 6.1 Health policy response to AAS use

The UK responded quickly to the threat of an HIV epidemic amongst people who inject drugs (Stimson, 1995, Stimson, 1996), and adapted to the changing profile of drug users (McVeigh et al., 2003b), in particular the increase in AAS use from the early 1990s (McVeigh et al., 2003a), (McVeigh and Begley, 2017). Similarly to the UK harm reduction initiatives in the 1980s, interventions were established prior to central Government guidelines or

recommendations (Stimson, 1995). It was not until 2008 that guidelines on optimal provision of NSP was published. Initial systematic reviews and NICE recommendations and the subsequent publications provided a template for NSP service targeting those who inject AAS (Bates et al., 2013, Kean, 2014, McVeigh, 2017d, NICE, 2009, NICE, 2017, Jones, 2013, Jones et al., 2008, Jones et al., 2010). However, barriers to NSP service engagement persisted in parts of the UK (Kimergard and McVeigh, 2014c), with users of AAS respecting and adhering to peer advice rather than public health information (Kimergard and McVeigh, 2014a). In the event of adverse effects, AAS were as likely to self-treat (43%) or simply wait and hope that they would resolve on their own (45%), as they would seek treatment from a health practitioner (McVeigh et al., 2015a). There remains scant evidence to support methods of health promotion, drug use prevention or harm reduction other than NSP, with robust effectiveness evaluations published (McVeigh and Begley, 2017, Backhouse et al., 2014, Bates et al., 2017a). These conclusions were provided in expert testimony to NICE (McVeigh, 2017d) and incorporated into NICE guidelines (NICE, 2017).

#### 6.1.2 Response to BBV transmission in the UK and internationally

Vaccination and treatment of BBV remains a major concern with less than a quarter of AAS injectors receiving any hepatitis B vaccination (Hope et al., 2013c, Begley et al., 2017). Hepatitis C, present in 5% of AAS injectors, remains undiagnosed in the majority of AAS injectors who had not injected a psychoactive drug. Uptake of viral screening was poor, with only 40% of AAS injectors having ever been tested for hepatitis C (Hope et al., 2017). In response to localised infections, only 17% sought medical assistance for redness tenderness and swelling. Although 76% of those who had experienced an abscess, or open wound at an

injection site presented to health services, nearly half (47%) had attended an accident and emergency clinic, and 26% had attempted self-treatment (Hope et al., 2015).

Similarly to the UK, Ireland also lacks robust population level research into the use of AAS and associated drugs (Curtin et al., 2017). The All-Ireland drug prevalence survey in 2010/11 indicated the established use of AAS (lifetime prevalence of 2%), supporting the evidence of case reports (McElrath and Connolly, 2006) although prevalence was not recently reported by the Ireland Focal Point to the European Monitoring Centre for Drugs and Drug Addiction (National Advisory Committee on Drugs, 2012, Curtin et al., 2017). Research published in Dublin 2014 highlighted a vibrant community of anabolic steroid users (Jennings et al., 2014). An evaluation of needle and syringe provision (NSP) in Ireland indicated that anabolic steroid users constituted the second largest group of clients of needle and syringe programmes (Bates et al., 2015). Despite this and increasing numbers of reports on AAS use in the Irish media (Tuite, 2017, Darcy, 2016, O'Regan, 2017a, O'Regan, 2017b, Walsh, 2017, Jones, 2017), the issue, has to date, received little policy or strategy attention in Ireland (Jennings et al., 2014). Following on from the NSP evaluation (Bates et al., 2015), produced a qualitative paper on pharmacist experiences of NSP in Ireland (McVeigh et al., 2017b). Amongst the key implications for policy that were identified in the study, was the lack of a concerted public health response to injecting drug use, in particular the lack of targeted interventions for the relatively new cohort of people who inject AAS in Ireland (McVeigh et al., 2017b).

### 6.1.3 Engagement and barriers

Building on earlier work in both in Australia (Larance et al., 2008) and UK (Kimergard and McVeigh, 2014c), data from the Global Drug Survey indicated that poor health service uptake by users of AAS was a global issue, with the vast majority (86%) believing that their doctor would not be willing to help them and a quarter believing that their general practitioner did not have the necessary knowledge to help them (Zahnow et al., 2017). Only a minority of those who had engaged with a General Practitioner in relation to their AAS reported that any discussion had taken place regarding mood or psychological wellbeing (33.8%). However, AAS users were more likely to present to health services if concerned about sexual function. This may provide some insight to how monitoring and treatment of health problems amongst AAS users could be targeted.

#### 6.1.4 The impact of changes in UK drugs legislation on the use of anabolic androgenic steroids

Regardless of changes to the Misuse of Drugs Act (1971) in the UK in 1996, 2001 and 2010 there remains no evidence of any positive impact on prevalence or associated harms of AAS use or other image and performance enhancing drugs (ACMD, 2010b, Corazza et al., 2014, Evans-Brown and McVeigh, 2009a, Evans-Brown et al., 2012, Lenehan and McVeigh, 1998, McVeigh, 1996, McVeigh, 2018b, McVeigh et al., 2012a). The biggest source of AAS and associated drugs remains the illicit market (Siva, 2010, Schnetzler et al., 2010, Eaton et al., 2006, McVeigh et al., 2015a, McVeigh and Begley, 2017), furthermore, regardless of different forms of legislation in different countries (ACMD, 2010b, Denham, 2006, Kleinman and Petit, 1993, Yesalis et al., 1997) there remains little variation in prevalence of use (Sagoe et al., 2014c, Sagoe and Pallesen, 2018, Nakhaee et al., 2013, Santos et al., 2010, Buckley, 1988, Stubbe et al., 2014, Sagoe et al., 2015b, Bahri et al., 2017, Ip et al., 2017,

Pope et al., 2014a) or associated practices and harms (Sagoe et al., 2014a, Sagoe et al., 2014b, Sagoe et al., 2015a, Zahnw et al., 2017, Diclemente, 2014, McVeigh et al., 2015a, Begley et al., 2017, McVeigh, 2017a, McVeigh, 2018a).

## 6.2 Conclusions

The UK has developed and adapted NSP to the needs of AAS injectors to varying degrees across the UK. Research by McVeigh and colleagues has had a significant influence over the last 20 years (McVeigh et al., 2003a, McVeigh and Begley, 2017), contributing to legislation (ACMD, 2010b), NICE guidelines (NICE, 2014, NICE, 2009, NICE, 2017), public health strategy (PHE, 2014) and clinical guidelines for the management of substance misuse (Department of Health, 2017). However, concerns raised in the 1990s regarding primary care provision to AAS users (McVeigh, 1996, Lenehan et al., 1996) continue in the UK (McVeigh et al., 2015a) and internationally (Zahnw et al., 2017).

## Section 7: Reflection, conclusions and future direction

During the period of this research I have matured from an enthusiastic, inexperienced researcher to a more informed and measured observer and commentator. While the influence of academic collaborators and role models should not be underestimated, the engagement with the AAS using communities and their acceptance of me, as a neutral outsider has been paramount.

There has been significant progress over the last 25 years in the generation of new evidence and the increase in our understanding of many of the issues associated with AAS and associated drugs. We now have a much improved understanding of the scale of the issue (McVeigh, 2017c), although we still have no robust evidence as to the incidence nor prevalence (ACMD, 2010b, McVeigh et al., 2012a, McVeigh and Begley, 2017). However, the foci of the research, the methodologies used, the reporting of findings and the conclusions and recommendations made, are all subject to potential bias. The issues related to HIV prevalence amongst users of AAS exemplifies the potential for bias, misinterpretation and the further withdrawal of an already hard to reach population. While the identification of an HIV prevalence of approximately 1% - 2% amongst those sampled in the United Kingdom is robust (Hope et al., 2016, Hope et al., 2013b), there is caution required when extrapolating these data across the whole population of people who use AAS and it is clearly not generalizable across all AAS using communities. While care was taken within the cited papers to emphasize that transmission may have occurred through routes other than sharing injecting equipment used for AAS, for example, previous psychoactive injecting behaviour or sexual contact, individuals within some communities of AAS users responded negatively to these publications (Underwood, In press). Their response to what they believed was an inaccurate reflection of AAS injecting practices, created further barriers to

effective engagement with their communities. We now recognise the heterogeneity of AAS users, the different typologies (Zahnow et al., 2018, Christiansen et al., 2016), together with both established and emerging subpopulations of users (Van Hout and Kean, 2015, Metastasio et al., 2018). We are starting to appreciate some of the often complex and multi-faceted drivers and decision processes associated with this drug use (Boardley et al., 2014, Till et al., 2016). We now have a much improved appreciation of the practices of AAS drug use and associated risks. In particular, evidence from the national IPED studies (Bates and McVeigh, 2016, Begley et al., 2017, Chandler and McVeigh, 2014, McVeigh, 2017c) have identified the increasing array of available drugs (Evans-Brown and McVeigh, 2009b) and the growing trend of 'blast and cruise', which sees AAS users remain 'on cycle' without breaks.

Adulterated AAS and associated drugs and their potential for harm is nothing new (McVeigh and Lenehan, 1994), however, academic outputs as part of this portfolio of research, illustrate both the extent and the public health implications of the issue (Evans-Brown et al., 2009b, Kimergard et al., 2014b, Evans-Brown et al., 2014, Kimergard et al., 2014a, Breindahl et al., 2015).

The public health significance of the identification of significant levels of HIV within the AAS using community (Hope et al., 2013c, Hope et al., 2016) cannot be lost although we clearly need a better understanding of transmission routes. This, together with evidence of undiagnosed hepatitis C, constitute a major concern for public health. The prevention of BBV transmission has been at the heart of the UK's harm reduction strategy for many years. Research submitted as part of this portfolio of research has had a significant impact on health policy both in the UK and overseas. However, while BBV remains a public health priority within NSPs (Jones et al., 2010, Bates et al., 2013, Jones, 2013, Kimergard and



McVeigh, 2014b, McVeigh et al., 2015b, Iversen et al., 2016, McVeigh et al., 2016b, McVeigh and Begley, 2017), in relation to prevalence (Hope et al., 2013a, Hope et al., 2016) and associated risk behaviours (Hope et al., 2017, Glass et al., 2018) health professionals must be cognisant of the priorities and concerns of the individual AAS users (Kimergard and McVeigh, 2014b, Kimergard and McVeigh, 2014a, Kimergard, 2015), even if they considered to have a lower potential for harm (Hope et al., 2015).

Large numbers of AAS users are accessing NSP services in parts of the North of England, Scotland and Wales (Kimergard and McVeigh, 2014c, Chandler and McVeigh, 2014, McVeigh et al., 2015a, Bates and McVeigh, 2016, McVeigh and Begley, 2017, Begley et al., 2017, McVeigh, 2018a). However, despite national guidance to the contrary, there remains no standard provision or evaluation of prevention or harm reduction (NICE, 2014, NICE, 2009, HM Government, 2017, Public Health England, 2015, Department of Health, 2017) interventions.

The innovative substance use surveillance systems developed at the Public Health Institute under the direction of the author of this portfolio of work (Whitfield et al., 2017) have provided essential intelligence regarding service activity and outcomes of those using AAS (Chandler et al., 2009, McVeigh et al., 2003b). This unique longitudinal monitoring system of AAS service provision is the only source of robust trend data (McVeigh et al., 2003a, McVeigh and Begley, 2017). Qualitative research conducted by McVeigh and colleagues has identified significant barriers to the development of effective engagement and delivery of interventions in the UK (Kimergard and McVeigh, 2014a, Kimergard and McVeigh, 2014c).

## Summary of contribution to evidence and understanding of AAS use

### Changes in extent, characteristics and practices of AAS users

- Significant increases in the number of AAS injectors engaging with NSP across UK.
- Health service gap for AAS users who do not inject
- Diffusion of use from central urban post-industrial cities to suburban and rural areas.
- Increased numbers of older AAS users due to cohort effect and later onset of use.
- More diverse motivations for use, typology of user and risk profile.
- High levels of psychoactive drug use amongst AAS users.
- Population of AAS users who have previously injected psychoactive drugs.
- Increasing prevalence of human growth hormone.
- Increased use of new peptide hormones including melanotan, MGF and GHRP-6.
- Re-emergence of DNP amongst AAS users and its diffusion to the wider population.
- Increased dosages, longer cycles and the introduction of “blast & cruise” regimens.

### Evidence of harm related to the use of AAS and associated drugs

- Confirmation of established harms through systematic review
- Significant number of HIV positive users of AAS in the United Kingdom.
- Hepatitis B and hepatitis C infection amongst AAS users.
- Low levels of hepatitis c testing and diagnosis amongst AAS using population.
- Psychoactive drug use, sex between men and imprisonment predictive of infection.
- Sharing of injecting equipment amongst sub-populations of AAS users.
- High levels of unprotected sex amongst AAS users.
- Common localised infection such as abscess formation and soft tissue injury.
- Adulteration and substitution of active ingredients resulting in harm.
- Wide variation in strength of illicitly manufactured AAS and associated drugs.
- Adulteration of supplements with AAS and associated drugs.
- The ease of availability and low understanding of risks associated with DNP.

### The health and drug policy response to the emerging public health issue

- NSPs in UK engaged with large numbers of AAS injectors.
- Wide variation in NSP service uptake and engagement across the UK.
- Little evidence of effectiveness of engagement strategies with AAS users.
- Mistrust of academics and health service amongst many AAS users.
- Reluctance of AAS users to declare use or seek treatment for harms.
- Blood borne virus testing and vaccination remains low amongst AAS users.
- Inadequate response to AAS use in Ireland.
- Potential for greater engagement of AAS users via sexual health services.
- Recognition of AAS use within UK clinical guidelines and drugs policy.
- Legislation changes have not impacted on prevalence of AAS use.
- Negative unintended health consequences of legislation.

Furthermore, work conducted in Ireland (Bates et al., 2015, McVeigh et al., 2017b), illustrated the situation in a country which has yet to respond to the public health challenges posed by AAS use. Findings from the (Zahnow et al., 2017) provide evidence of the issue impacting on regions around the world, with countries such as Brazil facing even greater challenges than the UK. The epidemiological complexity of AAS use is further highlighted at sub-population level, with the differing beliefs, practices and motivations for use of AAS amongst third generation South Asian men in the UK (Van Hout and Kean, 2015).

Significant progress has been made over the last 25 years in relation to our understanding of AAS user populations, their characteristics and practices (Zahnow et al., 2018); the potential harms associated with use (Begley et al., 2017, Hope et al., 2017, Hope et al., 2016, Hope et al., 2013c, Hope et al., 2015, McVeigh et al., 2015a) and the extent of interventions to prevent the transmission of BBV amongst AAS users (McVeigh and Begley, 2017, McVeigh et al., 2003a). However, there remains scant evidence relating to effective interventions to prevent the uptake of AAS (McVeigh, 2017d, Bates et al., 2017a); reduce harms and promote health amongst users (Bates et al., 2013, ACMD, 2010b, Evans-Brown and McVeigh, 2009a) and to support the cessation of use (Kanayama et al., 2010a). Where evidence of treatment or interventions for AAS users is available, it is largely confined to the symptomatic treatment of associated health harms (cardiovascular, hepatic, renal, sexual, behavioural and affective) rather than cessation or harm reduction.

We remain at the early stages of recognising the complex and interrelated motivations and drivers of AAS use amongst different populations. With the aim of delivery and evaluation of interventions, new research will need to identify the key triggers and levers, which facilitate

the decision-making processes related to AAS use and progression to AAS use problems and potential dependence. These findings will be essential to inform the development and delivery of culturally sensitive interventions that address both personal and environmental factors. As the academic, multidisciplinary field of AAS use matures, we need to build on the low level, anecdotal and descriptive accounts of service provision that support the potential for tailored service provision resulting in ongoing service engagement with the target population. Further work is required relating to the reluctance and mistrust of health services, including primary care, amongst sections of the AAS using communities. The diverse typologies of AAS using populations with variable risk profiles and health concerns highlight the need for multiple approaches to meaningful health engagement. Finally, while for some populations, AAS use is just one aspect of risk behaviour alongside combinations of unprotected sex with multiple partners, psychoactive drug use, previous psychoactive drug injection, undiagnosed BBV status, previous incarceration while for others moderate AAS use may be a single factor within an otherwise health conscious lifestyle.

Perhaps the main contribution of this thesis to the AAS evidence base, is the identification that the issues are far more complex and the population far more diverse than previously reported or recognised. While evidence based practice in relation to the prevention of AAS use and the reduction of harm amongst those that choose to use these drugs, remain distant goals, the research within the thesis provides a worthwhile contribution to the foundations on which to build.

## Section 8: References

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## Appendix I: Submitted Papers

- 1) 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
- 2) 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
- 3) Zahnow, R., McVeigh, J., Ferris, J., & Winstock, A. (2017). Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users. *Contemporary Drug Problems* 44(1):69-83 01
- 4) McVeigh, J., Germain, J., & Van Hout, M. C. (2016). 2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness. *Journal of Substance Use*, 22(2), 131-138.
- 5) McVeigh, J., Hearne, E., Bates, G., & Van Hout, M. C. (2016). Community pharmacist experiences of providing needle and syringe programmes in Ireland. *Research in Social and Administrative Pharmacy*. S1551-7411(16)30310-2
- 6) Kimergard, A., & McVeigh, J. (2014). Environments, risk and health harms: a qualitative investigation into the illicit use of anabolic steroids among people using harm reduction services in the UK. *BMJ Open*, 4(6), 7 pages. doi:10.1136/bmjopen-2014-005275
- 7) Hope, V. D., McVeigh, J., Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., Croxford S., Beynon C. M., Parry J. V., Bellis, M. 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),
- 8) McVeigh, J., Beynon, C., & Bellis, M. A. (2003). New challenges for agency based syringe exchange schemes: Analysis of 11 years of data (1991-2001) in Merseyside and Cheshire, United Kingdom. *International Journal of Drug Policy*, 14(5-6), 399-405.



## **Appendix II: Supplemental material**

### **Appendix II.1 Supplemental peer-reviewed journal papers**

9) 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*.

Journal Impact Factor 0.94 Citations - Altmetric 17

Contribution: Last author responsible for co-conception of study, co-development of methodology, co-analysis and 25% writing of paper. Guarantor of paper

10) Hope, VD, **McVeigh, J** Smith, J. Glass, R, Njoroge, J, Tanner, C, Parry, JV, Ncube, F, Desai M (2017) Low levels of hepatitis C diagnosis and testing uptake among people who inject image and performance enhancing drugs in England and Wales, 2012-15 *Drug and Alcohol Dependence* Volume 179, Pages 83–86

Journal Impact Factor 3.22 Citations – Altmetric 26

Contribution: Second author responsible for co-conception of study, co-development of methodology, co-analysis and 30% writing of paper.

11) 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 Performance Enhancing Drugs in England and Wales: Results From Cross-Sectional Prevalence Surveys, 1992-2013. *JAIDS-Journal of Acquired Immune Deficiency Syndrome*, 71(3), 331-337.

Journal Impact Factor 3.9 Citations 6 Altmetric 4

Contribution: Co- author responsible for co-conception of study, co-development of methodology, and 30% writing of paper.

12) Sagoe, D., **McVeigh, J.**, Bjornebekk, A., Essilfie, M. -S., Andreassen, C. S., & Pallesen, S. (2015). Polypharmacy among anabolic-androgenic steroid users: a descriptive metasynthesis. *Substance Abuse Treatment Prevention and Policy*, 10, 19 pages.

Journal Impact Factor 1.81 Citations 31 Altmetric 10

Contribution: Second author responsible for co-conception of study, co-development of methodology, co-analysis and 35% writing of paper.

13) Breindahl, T., Evans-Brown, M., Hindersson, P., **McVeigh, J.**, Bellis, M., Stensballe, A., & Kimergard, A. (2015). Identification and characterization by LC-UV-MS/MS of melanotan II skin-tanning products sold illegally on the Internet. *Drug Testing and Analysis*, 7(2), 164-172.

Journal Impact Factor 3.47 Citations 16 Altmetric 7

Contribution: Co-author responsible for co-conception of study, co-development of methodology and 20% writing of paper.

14) Hope, V. D., **McVeigh, J.**, Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., Parry J. V. & Ncube, F. (2015). Injection site infections and injuries in men who inject image- and performance-enhancing drugs: prevalence, risks factors, and healthcare seeking. *Epidemiology and Infection*, 143(1), 132-140.

Journal Impact Factor 2.08 Citations 9 Altmetric 7

Contribution: Second author responsible for co-conception of study, co-development of methodology, co-analysis and 30% writing of paper.

15) Abbate, V., Kicman, A. T., Evans-Brown, M., **McVeigh, J.**, Cowan, D. A., Wilson, C., . . . Walker, C. J. (2015). Anabolic steroids detected in bodybuilding dietary supplements - a significant risk to public health. *Drug Testing and Analysis*, 7(7), 609-618.

Journal Impact Factor 3.47 Citations 30 Altmetric 179

Contribution: Co- author responsible for co-conception of study, co-development of methodology, co-analysis and 35% writing of paper.

16) Kimergard, A., & **McVeigh, J.** (2014). Variability and dilemmas in harm reduction for anabolic steroid users in the UK: a multi-area interview study. *Harm reduction Journal*, 11, 13 pages

Journal Impact Factor 1.88 Citations 17 Altmetric 20

Contribution: Second author responsible for co-conception of study, co-development of methodology, co-analysis and 45% writing of paper and guarantor of paper.

## **Appendix II.2 Additional peer-reviewed journal papers, editorials, systematic reviews**

17) Bates, G., Begley, E., Tod, D., Jones, L., Leavey, C., & **McVeigh, J.** (2017). A systematic review investigating the behaviour change strategies in interventions to prevent misuse of anabolic steroids. *Journal of Health Psychology*, 1359105317737607

Journal Impact Factor 2.18 Citations 1 Altmetric 11

Contribution: Co-author responsible for co-conception of study, co-development of methodology, 20% writing and guarantor of paper.

18) **McVeigh, J.**, Kimergard, A., Bates, G., Hope, V., & Ncube, F. (2006). Focus on harm reduction in fight against HIV, says report. *BMJ-British Medical Journal*.

Journal Impact Factor 20.79

Contribution: Principle author responsible for conception and writing of paper.

19) Iversen, J., Hope, V. D., & **McVeigh, J.** (2016). Access to needle and syringe programs by people who inject image and performance enhancing drugs. *International Journal of Drug Policy*, 31, 199-200

Journal Impact Factor 3.48 Citations 5 Altmetric 6

Contribution: Co-author responsible for co-conception and co-writing paper and guarantor of paper.

20) Stensballe, A., **McVeigh, J.**, Breindahl, T., & Kimergard, A. (2015) Synthetic Growth Hormone releasers detected in seized drugs: New trends in the use of performance enhancement. *Addiction*, 110(2), 368-369

Journal Impact Factor 5.79 Citations 5 Altmetric 7

Contribution: Second author responsible for co-conception of study, co-development of methodology, co-analysis and 25% writing of paper.

21) Kimergard, A., Breindahl, T., Hindersson, P., & **McVeigh, J.** (2014). The composition of anabolic steroids from the illicit market is largely unknown: implications for clinical case reports. *QJM-An International Journal of Medicine*, 107(7), 597-598.

Journal Impact Factor 3.13 Citations 5 Altmetric 5

Co- author responsible for co-conception of study, co-development of methodology, co-analysis and 20% writing of paper and guarantor of paper

22) Kimergard, A., **McVeigh, J.**, Knutsson, S., Breindahl, T., & Stensballe, A. (2014). Online marketing of synthetic peptide hormones: poor manufacturing, user safety, and challenges to public health. *Drug testing and Analysis*, 6(4), 396-398.

Journal Impact Factor 3.47 Citations – Altmetric 5

Second- author responsible for co-conception of study, co-development of methodology, co-analysis and 20% writing of paper.

23) Evans-Brown, M., Kimergard, A., **McVeigh, J.**, Chandler, M., & Brandt, S. D. (2014).

Bodybuilding Supplements: Is the breast cancer drug tamoxifen being sold as a bodybuilding dietary supplement? *BMJ-British Medical Journal*, 348, 2 pages.

Journal Impact Factor 20.79 Citations 10 Altmetric 85

Co-author responsible for co-conception of study, co-development of methodology, co-analysis and 20% writing of paper.

24) Hope, V., **McVeigh, J.**, Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., . . .

Ncube, F. (2013). Prevalence of, and risk factors for, human immunodeficiency virus, hepatitis B and hepatitis C infections among men who inject image- and performance-enhancing drugs in England & Wales. *HIV MEDICINE*, 14, 2.

Journal Impact Factor 3.26 Citations - Altmetric –

Contribution: Second author responsible for co-conception of study, co-development of methodology and 35% writing of paper.

25) **McVeigh, J.**, Evans-Brown, M., & Bellis, M. A. (2012). Human enhancement drugs and the pursuit of perfection. *Adicciones*, 24(3), 185-190.

Journal Impact Factor 2.08 Citations 18 Altmetric –

Contribution: Principle author responsible for conception of study, development of methodology, co-analysis and writing of paper.

26) Jones, L., Pickering, L., Sumnall, H., **McVeigh, J.**, & Bellis, M. A. (2010). Optimal provision of needle and syringe programmes for injecting drug users: A systematic review.

*International Journal of Drug Policy*, 21(5), 335-342.

Journal Impact Factor 3.48 Citations 9 Altmetric 6

Contribution: Co-author responsible for co-conception of study, co-development of methodology, co-analysis and 20% writing of paper.

27) Evans-Brown, M., Dawson, R. T., Chandler, M., & **McVeigh, J.** (2009). Use of melanotan I and II in the general population. *British Medical Journal*, 338, 3 pages.

Journal Impact Factor 20.79 Citations 29 Altmetric 19

Contribution: Co-author responsible for co-conception of study, 30% of writing and guarantor of paper.

28) Evans-Brown, M., Kimergard, A. & **McVeigh, J.** (2009) Elephant in the room? The methodological implications for public health research of performance-enhancing drugs derived from the illicit market. *Drug Testing and Analysis* 1(7-8):323-326  
Journal Impact Factor 3.47 Citations 18 Altmetric 19  
Co-author responsible for co-conception of study, co-development of methodology, co-analysis, 40% of writing and guarantor of paper.

29) Evans-Brown, M., & **McVeigh, J.** (2009) Injecting human growth hormone as a performance-enhancing drug-perspectives from the United Kingdom. *Journal of Substance Use* 14(5):267-288  
Journal Impact Factor 0.77 Citations 10 Altmetric 1  
Second author responsible for co-conception of study, 40% of writing and guarantor of paper.

30) Evans-Brown, M., Dawson, R., & **McVeigh, J.** (2008). The dire consequences of doping? *Lancet*, 372(9649), 1544.  
Journal Impact Factor 47.83  
Co-author responsible for co-conception of study, 30% of writing and guarantor of paper.

### **Appendix II.3 Selected minor peer reviewed papers, reports and book chapters**

31) Chester, N., & **McVeigh, J.** (2018). Drug Use in Society and the Impact on the Anti-Doping Movement. In D. R. Mottram, & N. Chester (Eds.), *Drugs in Sport*. London: Routledge.

32) Bates, G., Hope, V., & **McVeigh, J.** (2017). HIV among people using anabolic steroid in the United Kingdom: an overview. *HIV Nursing*, 17(1), 20-23

33) Begley, E., **McVeigh, J.**, Hope, V. D., Bates, G., Glass, R., Campbell, J., . . . Smith, J. (2017). Image and Performance Enhancing Drugs 2016 National Survey Results: Image and Performance Enhancing Drugs 2016 National Survey Results. Public Health Institute, Liverpool John Moores University.

34) Bates, G., & **McVeigh, J.** (2016). Image and Performance Enhancing Drugs 2015 Survey Results. Liverpool: Liverpool John Moores University.

35) **McVeigh, J.**, Bates, G., & Chandler, M. (2015). Steroids and Image Enhancing Drugs 2014 Survey Results. Liverpool John Moores University.

36) Bates, G., Van Hout, M. C., Hearne, E., Mackridge, A., **McVeigh, J.** (2015) Evaluation of the pilot stage of the Pharmacy Needle Exchange Programme in Ireland. Liverpool: Centre for Public Health, Liverpool John Moores University.

37) Bates, G., Jones, L., & **McVeigh, J.** (2013). Update of NICE Guidance PH18 on 'Needle and Syringe programmes. PIEDs Review. Centre for Public Health, Liverpool John Moores University.

38) Evans-Brown, M., **McVeigh, J.**, Perkins, C., & Bellis, M. A. (2012). Human Enhancement Drugs - The Emerging Challenges to Public Health: Human Enhancement Drugs - The Emerging Challenges to Public Health. Liverpool: Centre for Public Health, Liverpool John Moores University.

39) Evans-Brown, M., **McVeigh, J.** Anabolic steroid use in the general population of the United Kingdom In Elite Sport, Doping and Public Health. Editors: Dimeo P, McNamee M, Moller V. (2009) 75-97 (22 pages). Univ Pr of Southern Denmark.

40) Jones, L., Pickering, L., Sumnall, H., **McVeigh, J.**, & Bellis, M. (2008). A review of the effectiveness and cost-effectiveness of needle and syringe programmes for injecting drug users. Centre for Public Health, Liverpool John Moores University

41) Jones, L., Bates, G., Beynon, C., Duffy, P., Evans-Brown, M., Mackridge, A., McCoy, E., Sumnall, H., Bellis, M., **McVeigh, J.**, & (2008). A summary of the health harms of drugs. London: The Department of Health.

42) **McVeigh, J.**, & Evans-Brown, M. J. (2009). Anabolic steroids. Network, 25.

Evans-Brown, M. J., & **McVeigh, J.** (2008). An Introduction to anabolic steroids. Sportex Medicine, (38), 20-26

43) **McVeigh, J.**, Hughes, K. E., Hounscome, J., & Bellis, M. (2003). Over a Decade of Drug Use Epidemiology. Centre for Public Health - Liverpool John Moores University

44) Lenehan, P., & **McVeigh, J.** (1998). Anabolic Steroids: a guide for professionals. Liverpool: University of Liverpool.

45) **McVeigh, J.** (1996). Survey of gym owners' opinions on the use of performance enhancing drugs. Journal of Performance Enhancing Drugs, (1), 21-24.

46) Korkia, P., Lenehan, P., & **McVeigh, J.** (1996). Non-medical use of androgens among women. Journal of Performance Enhancing Drugs, (2), 71-76.

#### **Appendix II.4 Recent examples of plenary and keynote conference presentations (Last 2017/18)**

47) **McVeigh, J.** (2018) Anabolic androgenic steroids & HIV: prevalence, risks & implications. Fourth Joint Conference of BHIVA with BASHH. Edinburgh: 17th - 20th April 2018

48) **McVeigh, J.** (2018) The public health implications of anabolic steroid use in the United Kingdom. A shot in the Dark: Steroids, IPEDs - the Hidden Harm Conference. Colchester. 26th April 2018

49) **McVeigh, J** (2017) The range of IPEDs, user populations and motivations for use. Scottish Drugs Forum – Image and Performance Enhancing Drugs Conference  
Glasgow: 21st – 22nd March 2017

50) **McVeigh, J** (2017) Image and performance enhancing drug use in the United Kingdom: challenges and implications. Doping in Sport, Doping in Society – Lessons, Themes and Connections Conference. Aarhus: 23rd – 25th August 2017

51) **McVeigh, J** (2017) Changes in IPED use and concerns over last 20 years. Institute for Health Research Image and Performance Enhancing Drug Use Conference. Liverpool: 3rd October 2017

52) **McVeigh, J** (2017) Anabolic steroids: a global public health perspective. . Lisbon Addictions 2nd European conference on addictive behaviour and dependencies. Lisbon. 23rd – 25th October: 2017