

Doping in Sport:
**An interdisciplinary study of its
management and prevention**

A Thesis Submitted by

Aaron Hermann

Bachelor of Archaeology

Honours Degree of Bachelor of Arts

Master of Business Law

Master of Commerce

Professional Certification in Arbitration

Graduate Diploma in Nanotechnology

Master of Laws (International Law and International Relations)

Master of Diplomatic Studies

For the degree

Doctor of Philosophy

School of Medical Sciences

Anatomy and Pathology

The University of Adelaide

November 2014

Table of Contents

Abstract:	5
Introduction:	6
Overview and interconnectivity of papers	9
Declaration	16
Acknowledgements	17
Author Contributions:	19
<i>Manuscripts included in this thesis:</i>	19
Author Contributions for Paper 1 - The Doping Myth: 100m sprint results are not improved by “doping”	20
Author Contributions for Paper 2 - Title: Long term effects of doping in sporting records: 1886-2012	21
Author Contributions for Paper 3 - Title: Anti-doping systems in sports are doomed to fail: a probability and cost analysis	22
Author Contributions for Paper 4 - Classical positions on doping and their usefulness to modern sports policy	23
Author Contributions for Paper 5 - ‘Pool of Responsibility’: A new approach to doping prevention	24
Paper 1 - Title: The Doping Myth: 100m sprint results are not improved by “doping”	25
Abstract	26
1. Introduction	28
2. Materials and Methods	29
3. Results	31
4. Discussion	35
5. Conclusion	40
6. Perspective	40
Acknowledgments	40
References	41
Paper 2 - Title: Long term effects of doping in sporting records: 1886-2012	44
Abstract	45
1. Introduction	46
2. Materials and Methods	48
3. Results	51
4. Discussion	60
5. Conclusion	66
6. Perspective	67
Acknowledgments	67
References	68
Paper 3 - Title: Anti-doping systems in sports are doomed to fail: a probability and cost analysis	72
Abstract	73
1. Introduction	74
1.1 Anti-doping policies and realities	77

1.1.1 Human Health.....	77
1.2 Effectiveness according to some experts.....	80
1.3 Window of Detection.....	81
1.4 Test Sensitivity.....	83
1.5 Doping Regime	84
1.6 Predictability of Testing.....	85
2. Methods	86
3. Results and Discussion.....	91
3.1 Odds of Doping Detection	91
3.2 Rates of Doping.....	101
3.3 Testing Requirements	104
3.4 The Cost of Effective Anti-Doping	106
3.5 Biological Passport and Forensic Testing.....	108
4. Limitations and Future Research	111
5. Conclusions.....	111
Acknowledgments.....	112
References	113
Paper 4 - Title: Classical positions on doping and their usefulness to modern sports policy	122
Abstract.....	123
1. Introduction.....	124
1.1 Why?.....	126
2. Similarities between classical sports and modern sports.....	129
2.1 Athletes Health and Anti-doping	137
3. Classical practices and their link to ‘doping’.....	139
3.1 Societal and Cultural Linkage	140
4. Policy implications and recommendations	144
5. Conclusion	146
Bibliography	148
Paper 5 - Title: ‘Pool of Responsibility’: A new approach to doping prevention	155
Abstract.....	156
1. Anti-doping Arguments: A Critique	158
1.1. Fairness and Equality.....	158
1.2. Athlete’s Health.....	162
1.3. Appearances, Perceptions and Revenue	163
2. ‘Pool of Responsibility’: A Novel Approach	164
2.1. The Concept	165
2.2. The Organisational Arena	167
2.3. The Case Studies	170

2.4. The Legal Arena	173
3. 'Pool of Responsibility': The Application.....	178
Conclusions.....	180
References	181
Impacts of this research.....	190
1. Citations.....	190
2. Media Coverage	191
3. Other Impacts.....	192
Findings of the Research.....	193
Conclusions	195
Additional References	201
Appendix A – Published version of: The Doping 'Myth' - Anti-Doping Systems in Sports are not improved by 'doping', International Journal of Drug Policy, 24: 110–114	202
Appendix B – Published version of: Anti-Doping Systems in Sports are Doomed to Fail: A Probability and Cost Analysis. Journal of Sports Medicine and Doping Studies, 4: 148. doi:10.4172/2161-0673.1000148.....	207
Appendix C – Overview of media coverage arising from thesis research.....	219

Abstract:

This thesis addresses aspects of two key fields of research. One component addresses the areas of medicine and science, whilst the second addresses the areas of law and policy. This research contributes new results regarding effects of doping on sport achievements, the widespread nature of doping and offers new ideas to the area of anti-doping, anti-doping policy and law, and to the greater sporting arena. It firstly demonstrates that doping is far more widespread than official results would have one think. Doping is not confined to a limited few individuals, rather it is a widespread major problem in a number of sports throughout the world. It furthermore demonstrates that summer sports appear to have a greater problem with doping than winter sports. Next, it shows that current anti-doping testing and detection systems are inefficient and ineffective. The current system is structured such that a single test will, in most cases, not detect a doped athlete. Moreover, in order for the current system to be effective, testing and funding would need to be increased to such a level as to make anti-doping, and sports in general, economically unfeasible. This thesis also shows that in order to combat doping (given the realities of the sporting arena and the findings of the papers) there are a few different approaches which could be taken to change the laws and policies; firstly, a restructuring of how sports are promoted and more specifically how they are seen by spectators. This view focuses on sports being an entertainment medium. This may benefit in reducing or removing doping issues. The role sport plays in modern society is such that it often conflicts with many of the ideals in modern society. Finally, as has been demonstrated by many doping scandals of late and the realities of doping cases, that multiple individuals are often involved in such cases not just the doped athlete. As such, this thesis proposes a series of policy changes to expand the responsibility and liability for doping infringements.

Introduction:

Doping in sport has been an issue for more than 100 years. Since the earliest competitions of the modern era, doping has been used as a means of gaining advantage over one's competitor. Before the isolation of steroids in the 1930's, doping was very much a 'hit or miss' practice. Some individuals attempted it, but with unexpected and sometimes fatal result. Before this time doping lacked its systematic option. The isolation of steroids created the first opportunity to systematically and effectively dope. Since the 30's numerous high profile doping scandals have tainted not only promising skilled athletes, but also the wider sporting arena.

Perhaps worse still are the consequences some doping practices can have on the human body. These consequences have, on more than a few occasions, resulted in the untimely death of an athlete. Despite these potentially fatal consequences athletes still are willing to risk the chance of getting caught and potential death to gain the upper hand in hope of winning. Research by Goldman & Klatz (1992) showed that approximately half of the respondents in their survey stated they were willing to die after 5 years if they could be guaranteed success. This shows the state of doping in modern times. The very practice of doping is in direct conflict with some of the primary aims of sport in the modern era, that of fairness and spirit of equality, morality and ethics. All in all doping has come to be seen as one of the greatest evils in the modern sporting arena.

Anti-doping practices have been, in one form or another, in existence since the 1920's with the IAAF's acknowledgement of doping. However, it was only in 1967 that the first grand scale attempts to combat doping were introduced. The International Olympic Committee's

introduction of anti-doping rules and testing saw the beginning of an uphill battle to combat doping. Despite these valiant attempts, the early anti-doping systems, particularly the methods of testing, lacked effectiveness and efficiency; one could say it was introduced more as a method of prevention through fear as opposed to any reliable method of detection.

The last 60 years have seen major changes in anti-doping systems as well as the techniques to combat doping. These changes range from the introduction of the World Anti-Doping Agency, Out-of-competition testing, advancements in detection methods, through to education programs, widespread funding for doping research and national anti-doping associations etc. They have also changed both the way doping has been combatted and also the ways in which doping is undertaken by athletes.

Whilst there have been many positives originating from these changes, an unfortunate reality still exists. The nature of anti-doping policies in modern times is such that doping practices have become so clandestine and more difficult to discover, as to be even more difficult to combat than 60 years ago. Advancements in pharmaceuticals, drug development, science and techniques to introduce drugs into the human body all mean that doping today is more difficult to discover and combat than ever before. Despite policy makers', scientists', lawyers', managers' and educators' best efforts, doping still exists to this day and it appears to always have the upper hand over the anti-doping system.

The perpetual existence of these problems has wider reaching consequences, especially given the role sports play in modern times and modern society. The modern role of sports in society

means that doping has wider societal consequences than ever before. The vast quantities of money, the importance of sports in some people's everyday life and the level to which it is intertwined in, not only lives of adults, but also in the development of children and in some cases a nation's identity, demonstrates this wider reaching impact. The latter of these, a nation's identity, is such that today these impacts spread to encompass the realm of international relations between nations. Moreover, in some cases, these issues can cause serious social problems, including violence and potentially war. This impacts not only individuals, but also companies and the peaceful coexistence between nations as a whole.

As such, given these realities, the continuance of doping and the wider societal and global consequences, a new approach must be constructed in order to help combat doping. This thesis aims to ascertain the current state of doping in sports and to make recommendations to solve the problems faced by the modern and future sporting arenas. This is done in three ways. Firstly, this thesis begins with a determination of the current state of affairs in the sporting arena; what is the situation with doping in the modern times. Secondly, based upon the findings of the initial investigations it analyses the current anti-doping system, its effectiveness and efficiency in reaching its goals through means of an assessment of testing, detection and policy. Finally, again based upon the finding of the previous research it makes recommendations for policy makers, lawyers and sporting officials as to changes to the current systems to help prevent doping, not only combat it.

Overview and interconnectivity of papers

The first paper, contributing to this thesis, pertains to an assessment of the current state in the sporting area with regards to doping. This was performed in order to determine to what extent doping is impacting sports today and to what extent it is inherent in the modern sporting arena. This assessment was performed in order to obtain a better overall indication of the problem. It was felt that this was an important starting point, in order to provide a more effective and efficient solution to the doping problem. It was first necessary to assess exactly what is the current state of doping and to what extent this is a widespread issue or just an overhyped problem.

The first paper sets out to consider the situation with doping. A specific sport (100m sprints) was selected to ascertain the extent to which doping is impacting sports today and the extent to which it is present in the given sport. 100m sprints were selected for two reasons, 1) it is considered the prestige event of the summer Olympics, and 2) the performance results are such that they can be compared directly and the impact of doping can be determined. This analysis contained data relating to top 100m sprint results over the last 30 years of records. The study involved the comparison between times of known 'dopers' vs. those times of athletes without known doping histories. This was performed in order to ascertain any differences in the average achievements. The best performances of 63 males and 69 female athletes were analysed. Results showed that performance times of doped and 'non-doped' athletes did not differ significantly (males 9.89s identical with 'non-dopers' 9.89s, females 10.84s and 10.88s). This indicated that either doping is widespread in 100m sprints and dopers are simply not being caught, or doping does not help performance.

In order to assess which of these conclusions are more likely and in order to get a more complete picture of the current state of doping in the wider sporting arena, the second study expanded the statistical analysis. Additional research was required because using only a single sport would result in an incomplete and skewed impression. That is to say the findings of the first paper may be confined to just 100m sprints; perhaps abnormalities exist within 100m sprints which resulted in the findings of the research. As such it was necessary to expand this research to look at additional sports which could be classified into other sporting and biological categories.

The second study incorporated sports which could be classified as endurance sports (such as marathon), strength sports (such as shot-put) and winter sports (such as speed skating) so to also assess the extent to which the findings of the first paper are representative of the entire sporting arena. As such, paper 2 expanded the study. Moreover, it expanded the period of time of the analysis to include over 125 years of sporting records (1886-2012). The analysis consisted of over 1560 results across 26 different summer and winter sports. Findings of the second paper reinforced that of the first and showed similar trends. Performance times of those athletes considered 'doped' and 'non-doped' were not significantly different across a range of sports. Furthermore, this study assessed long term effects of doping, using non-linear regression techniques. Findings indicated that sporting results did not improve as predicted by results from earlier years. The only differences were found in winter sports. Winter sports were shown to have a very different trend to those of summer sports, the performance results in winter sports coincided with the expected extrapolations. These findings are reinforced when coupled with those of the first study. They indicate two key facts. Firstly, doping if not undertaken with full knowledge and education of the effects, which substances to use and how much to use etc. does not have the desired effects on results. Secondly, it also indicates that doping is more widespread than official anti-doping records indicate. The fact that some

sports show no differences in the performance of those athletes without known histories of doping and those with known usage may indicate that at least some are in fact doping and are simply not being caught.

These findings indicate that there are clearly issues with the current anti-doping systems. Both of the key findings point to the same conclusion. If doping is not working as expected and people are still participating, then there are issues with prevention techniques; and if doping is occurring and athletes are not being caught, then there is a clear and serious problem with the anti-doping systems, especially with testing and detection. These issues arise for a number of reasons. Not only because of the evolving nature of doping substances, i.e. that new substances are always being discovered, but also because of the nature of the testing systems. If doping is occurring and not being caught, then it shows that testing lacks the precision needed, there are problems with the techniques used, or there are realities about human biology and medical realities that have not been fully addressed with the current systems.

Given the evidence that doping is far more widespread and that dopers are not being caught, it was next necessary to assess why this is the case. Why is it that potentially large numbers of doped athletes are ‘slipping through the cracks’? As such, attention was turned to the current anti-doping system, specifically that of testing and detection. There have been claims made by a number of officials in the sporting world as well as athletes both past and present, that the biggest issue with doping and the lack of offenders being caught is because of issues in the testing. In one extreme case Christopher Froome (2014) a professional cyclist, claimed that during a training camp involving a number of high profile and successful cyclists no anti-doping tests were conducted at all. If this is the case, then the findings of the first two papers

need to be addressed by assessing the situation with the current anti-doping systems. Further justification to assess the current systems is that testing and detection plays the single largest role in combatting doping. If testing and detection is faulty, then athletes will not be deterred to undertake the practice. It plays a role not only in catching the offenders but in turn punishment and as such acts as a deterrent against future doping. If doping is widespread, then perhaps this deterrent is lacking.

Paper 3 therefore analyses the current testing and detection systems to determine the extent to which they are effective and efficient in meeting their desired goals of preventing, deterring and/or catching doping. It was shown, through use of mathematical modelling, that with the current systems of detection and testing, the likelihood of being detected in a single test can, on average, be as low as 2.9%. The results showed that the current system is unlikely to catch offenders. As such, it is unlikely to be an effective deterrent, for athletes do not fear being caught. This reality is said to be contributed to because of a number of scientific and human biology facts which may not have been full accounted for in the current anti-doping systems. Realities about how long agents are detectable, which agents are used, how often doping is performed and needed to be performed by athletes to reach their goals, and athletes access to information about testing all contribute to the success rate of doping testing. Moreover, it was found that if the current system of anti-doping detection and testing were to remain, then dramatic increases in the number of tests performed and money invested in the system would need to be introduced in order to make it truly effective. The numbers involved were such as to make anti-doping, and sports in general, economically unfeasible. These findings reinforce the findings of the first two papers. The current systems of testing and detection lack the necessary effectiveness, precision and efficiency, and as such it is completely possible that a number of athletes who dope are not being detected and as such this is impacting the results

obtained in a number of sports. This paper also discovered that one of the key barriers to successful anti-doping detection is athlete's access to information. Other third parties may be contributing to their doping actions, that others may be either influencing them or providing them with assistance. This paper demonstrates that changes are needed in the current system in order to prevent and/or detect doping when it occurs as opposed to years after the event (such as was the case with Lance Armstrong and United States Postal Cycling Team). The question remains, what form do these changes need to be? Changes will be needed to not only address not only the biological realities of the sporting world but also the financial realities and also the specifics of factors impacting on the decision to dope.

In order to better address the problems facing the current anti-doping systems, it was first necessary to consider the current systems, how they have changed and what differs now to the past. As such, given the results of the first, second and third paper, the realities of the anti-doping system's inefficiencies and the apparent widespread nature of doping, it was subsequently necessary to assess the current approach to anti-doping policies and how they have changed over time. After careful research and an investigation of factors influencing an athlete's decision to dope it was determined that one of the key issues with the current system is how sports are viewed today by athletes and spectators; basically the role sports play in society. Therefore, it was next necessary to investigate how these views have changed with time and how they are being considered today. This was done in order to better know what changes are needed and also to make appropriate recommendations that will result in more effective and efficient policies. As such, paper 4 investigated the history of doping, more specifically doping, anti-doping and sports role in life in classical times and modern times.

It was discovered that despite the fact that doping (in some form or another) has been conducted since ancient times, it has only become a major problem within the last 100 years. Given the ineffectiveness of the current system and given that it was not a problem historically, paper 4 investigated the history of doping and anti-doping in ancient times in order to see if some similar policies could be used today to help combat doping. It was discovered that social views of sport and the role sports played in ancient cultures had the largest impact on doping not being a problem in ancient times. More specifically, it was found that sports then, were very much an entertainment medium. Spectators saw it in this manner and as such, a change in spectators' views of sports in the modern era to that of entertainment may help combat doping or at least to reduce its impact. One additional finding to come out of this study reiterates a key finding of the third study, the role others have in an athlete's decision to dope. Ample evidence exists that shows that an individual's decision to dope is rarely made on their own. Influence from coaches, managers, scientists, medical practitioners, or other athletes all contribute to this decision. Doping scandals reveal that numerous other people play a role. Scandals such as with Lance Armstrong and the United States Postal Cycling Team, East Germany or Chinese Swimmers scandal all reveal that doping is rarely confined to one individual. In many cases this is not just influence but rather encouragement or assistance to dope. These factors contribute to the ineffectiveness of the current systems as also demonstrate that they need to be taken into greater consideration with regards to anti-doping policies.

Therefore, this discovery means that research relating to the extent to which current anti-doping systems only address the role of the individual vs. the role of external influences was needed. As such, further analysis was conducted regarding the factors surrounding the problems with anti-doping policies. Moreover, research into the factors in existence with relation to the major doping scandals being revealed in recent times was conducted. This was

done in order to make more practical recommendations to the current policies to combat doping.

Paper 5 addresses the problems faced with the current systems and the lack of responsibility borne by others involved in the athletes doping action. It proposes new policies incorporating these other responsible parties and makes recommendations on a concept termed 'pool of responsibility'. That is to say that the liability (and subsequent punishment) for doping is extended beyond just the individual to include all those involved in the doping case. The results of this paper not only address the realities of the sporting world, and the findings of the previous 4 papers but it also creates a new concept of anti-doping policy so as to better deter doping and deal with it when and if doping does occur.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

The author acknowledges that copyright of published works contained within this thesis resides with the copyright holder(s) of those works.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Aaron Hermann

Date

Acknowledgements

I would like to begin by thanking my supervisors for the invaluable input provided to during my studies. The time and effort they have each contributed to my research made my candidature both a rewarding and an enjoyable experience. Thank you all, Professor Maciej Henneberg, Professor Frank Rühli, Professor Rick Sarre, Professor Paul Babie, Dr Renata Henneberg and Dr Arthur Saniotis.

I would also like to acknowledge the staff at the University of Zürich, Switzerland particular the Institute of Evolutionary Medicine, for their support whilst visiting their institution.

Likewise, I would like to thank Professor Max Weber and Professor Teschler-Nicola from the University of Wien, Austria for their time during my stay in Vienna.

Dr Norbert Ballermann-Lim for his entertaining and helpful German classes. Thanks also go out to the staff at the International Summer School University of Regensburg, Bayern.

Special thanks go out to my parents, Oma and Opa, Uncle Egon, Auntie Traudl and Klara Lubej who supported me throughout my candidature and who never lost faith in me. Thank you all.

Finally, I dedicate this work to my Oma, who passed away during my candidature,

Vielen dank Oma, i vergessen di net.

Author Contributions:

Manuscripts included in this thesis:

1. Hermann A, Henneberg M (2014) The Doping ‘Myth’ - Anti-Doping Systems in Sports are not improved by 'doping', *International Journal of Drug Policy*, 24: 110–114
2. Hermann, A., & Henneberg, M., (2014), Long term effects of doping in sporting records: 1886-2012, *Journal for Human Sport and Exercise*, (Submitted, Under Review)
3. Hermann, A., & Henneberg, M., (2014) Anti-Doping Systems in Sports are Doomed to Fail: A Probability and Cost Analysis. *Journal of Sports Medicine and Doping Studies*, 4: 148. doi:10.4172/2161-0673.1000148
4. Hermann, A., (2014), Classical positions on doping and their usefulness to modern sports policy, *Sport, Ethics & Philosophy: Journal of the British Philosophy of Sport Association* (Submitted, Under Review)
5. Hermann, A., (2014), ‘Pool of Responsibility’: A new approach to doping prevention, *Acta Juridica Hungarica* (Accepted)

Author Contributions for Paper 1 - The Doping Myth: 100m sprint results are not improved by “doping”

Statement of Authorship

Title of Paper	The Doping Myth: 100 m sprint results are not improved by 'doping'
Publication Status	<input checked="" type="radio"/> Published, <input type="radio"/> Accepted for Publication, <input type="radio"/> Submitted for Publication, <input type="radio"/> Publication style
Publication Details	Hermann A, Henneberg M (2014) Anti-Doping Systems in Sports are not improved by 'doping', International Journal of Drug Policy, 24: 110–114

Author Contributions

By signing the Statement of Authorship, each author certifies that their stated contribution to the publication is accurate and that permission is granted for the publication to be included in the candidate's thesis.

Name of Principal Author (Candidate)	Aaron Hermann		
Contribution to the Paper	Initial idea formulation. Created first draft of the manuscript. Collected data used in research. Data analysis. Interpretation of results. Was corresponding author.		
Signature		Date	

Name of Co-Author	Professor Maciej Henneberg		
Contribution to the Paper	Data analysis, results interpretation. Additional comments.		
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Author Contributions for Paper 2 - Title: Long term effects of doping in sporting records: 1886-2012

Statement of Authorship

Title of Paper	Long term effects of doping in sporting records: 1886-2012
Publication Status	<input type="radio"/> Published, <input type="radio"/> Accepted for Publication, <input checked="" type="radio"/> Submitted for Publication, <input type="radio"/> Publication style
Publication Details	Hermann, A., & Henneberg, M., (2014), Long term effects of doping in sporting records: 1886-2012, Journal for Human Sport and Exercise, Submitted, Under Review

Author Contributions

By signing the Statement of Authorship, each author certifies that their stated contribution to the publication is accurate and that permission is granted for the publication to be included in the candidate's thesis.

Name of Principal Author (Candidate)	Aaron Hermann		
Contribution to the Paper	Idea. First draft of the manuscript. Data collection. Analysis of data. Interpretation of results. Was corresponding author.		
Signature		Date	

Name of Co-Author	Maciej Henneberg		
Contribution to the Paper	Analysis of statistical data. Interpretation of Results. Added additional comments.		
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Author Contributions for Paper 3 - Title: Anti-doping systems in sports are doomed to fail: a probability and cost analysis

Statement of Authorship

Title of Paper	Anti-doping systems in sports are doomed to fail: a probability and cost analysis
Publication Status	<input checked="" type="radio"/> Published, <input type="radio"/> Accepted for Publication, <input type="radio"/> Submitted for Publication, <input type="radio"/> Publication style
Publication Details	Hermann, A., & Henneberg, M., (2014) Anti-Doping Systems in Sports are Doomed to Fail: A Probability and Cost Analysis. Journal of Sports Medicine and Doping Studies, 4: 148. doi:10.4172/2161-0673.1000148

Author Contributions

By signing the Statement of Authorship, each author certifies that their stated contribution to the publication is accurate and that permission is granted for the publication to be included in the candidate's thesis.

Name of Principal Author (Candidate)	Aaron Hermann		
Contribution to the Paper	First draft of the manuscript. Data collection. Analysis of data. Interpretation of results. Was corresponding author.		
Signature		Date	

Name of Co-Author	Maciej Henneberg		
Contribution to the Paper	Analysis of statistical data. Interpretation of Results. Added additional comments.		
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Author Contributions for Paper 4 - Classical positions on doping and their usefulness to modern sports policy

Aaron Hermann was the sole author of all aspects of the paper.

Author Contributions for Paper 5 - 'Pool of Responsibility': A new approach to doping prevention

Aaron Hermann was the sole author of all aspects of the paper.