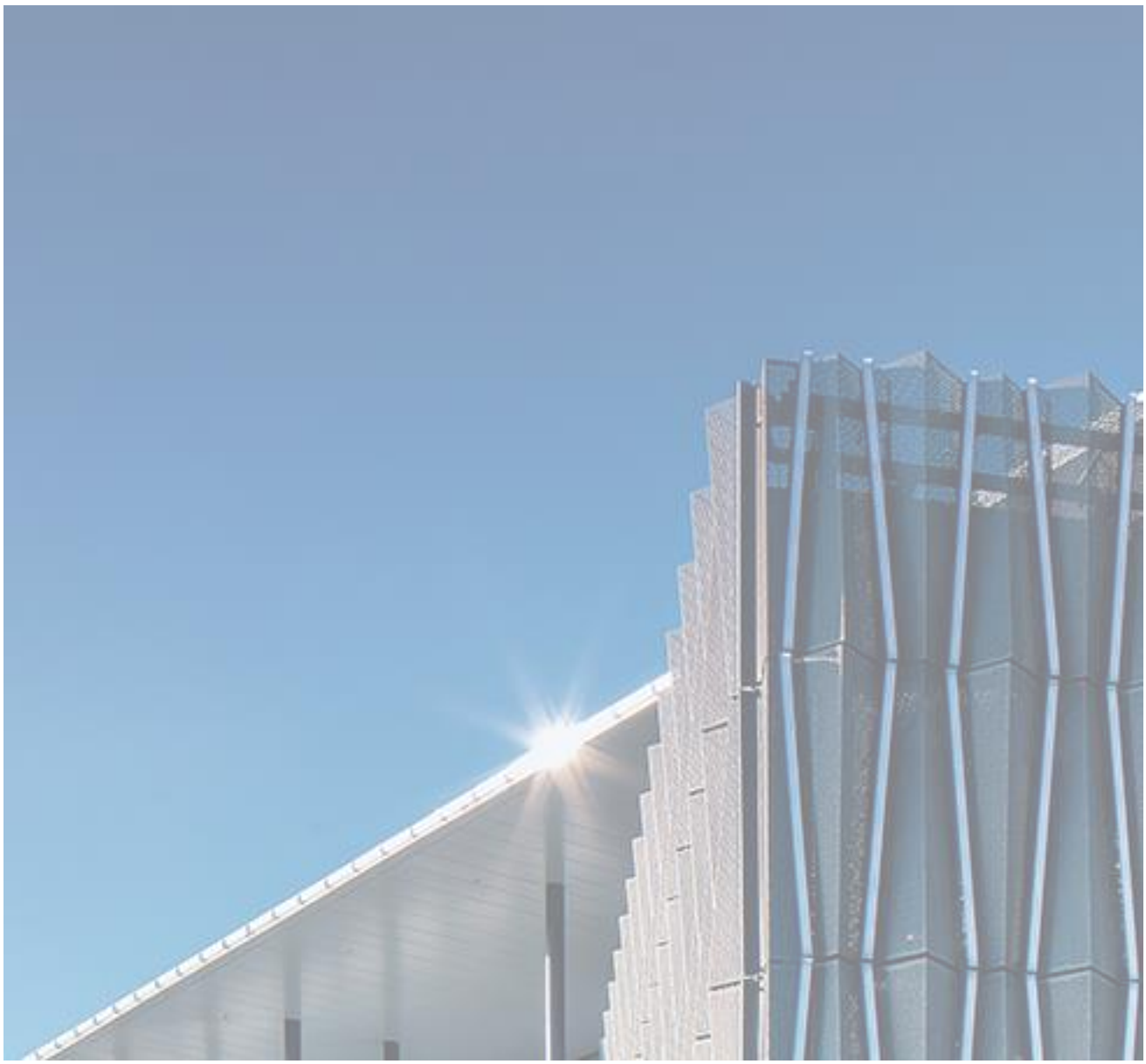

OPTIMISING ANTI-DOPING CONTROL SYSTEMS IN FOOTBALL CODES IN AUSTRALIA

WORLD ANTI-DOPING AGENCY SOCIAL SCIENCE RESEARCH GRANT

PROJECT REPORT 2023

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Contents

Executive Summary

The use of performance enhancing substances or 'doping' continues to represent a major risk in high performance sports. Doping occurs in a complex and dynamic environment that comprises multiple hierarchical levels of the system that cannot be easily explained or understood. However, the majority of research on doping has focused on the athlete and much less on the complex set of interactions occurring across the broader sports system. As such, novel approaches to understanding the systemic influences on doping in sport may help support the development of more effective prevention efforts. Systems thinking-based methods are one approach that is currently popular when attempting to understand and optimise the behaviour of complex systems. Part of the systems thinking approach involves applying a series of analytical modelling methods to understand the composition and behaviour of entire systems to support the identification of opportunities for optimisation.

As part of their ongoing anti-doping efforts, the World Anti-Doping Agency (WADA) through their Social Science Research Grants scheme funded the Centre for Human Factors and Sociotechnical Systems at the University of the Sunshine Coast to undertake an exploratory research project applying systems thinking methods to understand and strengthen the anti-doping system in four football codes in Australia (Football, Rugby League, Rigby Union, Australian Football). This report presents the findings from this work.

The aims of the research were to conduct an in-depth assessment of the current anti-doping system structure for football codes in Australia and to identify opportunities to strengthen it. This was achieved through the conduct of a systematic literature review; subject matter expert workshops; modelling of the anti-doping system; and a system systemic risk assessment which identifies where systemic control and feedback mechanisms are inadequate; how they could potentially fail; and finally, identifying areas to improve the anti-doping control structure.

This overarching research aim involved the following specific research questions:

1. Who are the actors (people) and organisations (international organisations, governments) currently involved in implementing controls for Anti-Doping in elite football codes in Australia?
2. What are the systemic controls to doping that are currently in place?
3. What feedback mechanisms enable us to judge how well existing controls are working?
4. How can we predict failures that will prevent controls from being effective?
5. What are the optimal interventions to address control failures?

Summary of Key Findings

- Doping in sport is an emeregnt property of the broader sports system.
- There are contributory factors to doping at each level of sport systems from international influences and government levels, through to the equipment and substances at the lower levels of the system.
- The current deterence-detection system appears to lack legitimacy to athletes as they percieve the penalties are low relative to the potential rewards on offer for doping-related improvements in performance.
- The anti-doping control structure model demonstrates the complexity of the anti-doping system through the specification of numerous actors that share the responsibility for anti-doping in Australia.
- Numerous controls identified in the model emphasise a profoundly bureaucratic system that is focused on education, detection, deterrence, and enforcement of actors at the lower levels of the system.
- The control structure identified that education is a key strategy for anti-doping agencies.
- The control structure identified notable missing feedback mechanisms include information regarding the effectiveness and reach of the education.
- 'Leverage points' exist whereby novel interventions could be used to strengthen the current doping control structure.
- The use of an integrated and systemic set of doping leading indicators could provide a useful feedback mechanism that enables proactive prevention.
- The control structure model indicates that, for anti-doping organisations to learn from incidents, a systems-thinking based incident reporting and learning system that looks 'up and out' at the broader system rather than 'down and in' at individual wrongdoing may be required.
- In total, 712 control and feedback risks were identified. It is recommended that sport system stakeholders review the STPA risks and their current control and feedback mechanisms to determine if further effort around the development or strengthening of control and feedback mechanisms is required.
- New controls not currently in place were identified, including a process for anonymous whistleblowing and reporting, sport specific risk assessments, guaranteed testing funding programmes, wastewater monitoring of banned substances, and darknet monitoring for banned substances and purchases.
- New feedback mechanisms not currently used were identified, including the effectiveness and reach of anti-doping education, anonymous athlete discussion forums, whistleblowing, publicly available reports on testing frequency, results, and finances, and player bargained anti-doping policy.

DISSEMINATION ACTIVITIES

Peer Reviewed Journal Articles

- Naughton, M., Salmon, PM., Kerehrve, H., McLean, S. Applying a systems thinking lens to anti-doping: A systematic review of contributory factors to doping in sport. Journal of Sports Sciences (Under Review).

- Mclean, S., Naughton, M., Kerhereve, H. Salmon, P.M. From Anti-Doping I to Anti-Doping II: Towards a paradigm shift in for doping prevention in sport. International Journal of Drug Policy (Under review)

Conference Presentations

- McLean, S., Naughton, M., Kerehrve, H., Salmon, PM. (2023). A systems thinking approach for doping prevention in football. World Congress of Science and Football. Groningen, Netherlands.

- Naughton, M., Salmon, PM., Kerehrve, H., McLean, S. (2022). Who is in control of anti-doping in soccer in Australia? World Congress on Science and Soccer. Coimbra, Portugal.

- McLean, S., Naughton, M., Kerehrve, H., Salmon, PM. (2022). Who is in control of anti-doping in the football codes in Australia? Applying a systems thinking lens for doping prevention. World-Anti Doping Agency Global Education Conference. Sydney Australia.

Part One. Introduction

Doping as a complex system

The use of performance enhancing substances (PES) or 'doping' continues to represent a major risk in high performance sports (Momaya, et al 2015; Ntoumanis et al, 2014; Pöppel et al, 2021). Doping violates the spirit of sport and poses risks to athlete health and well-being (Momaya et al., 2015; WADA, 2021a). Doping holds a unique place in the public psyche, in that it evokes intense division and debate among sports fans, as well as intense media coverage, as seen with high-profile cases such as Lance Armstrong, and the Russian state sponsored doping program (McLaren, 2016; Pöppel et al., 2021). This has caused many pundits and the public to believe doping is widespread, an opinion which is further compounded by the fact that the true prevalence of doping is not known (Aguilar-Navarro et al, 2020; Houlihan et al, 2019). The World Anti-Doping Agency (WADA) consistently report positive findings (from tests analysed in WADA laboratories) to be less than 2% each year (Ntoumanis et al., 2014). In contrast, multiple studies including those using self-reported instances of doping have found a substantially higher prevalence with estimates between 14% to 57% for competitive athletes (Aguilar-Navarro et al., 2020; Ulrich et al., 2018). Despite decades of doping prevention research, and efforts by anti-doping organisations, current approaches appear to be falling short of the intended goal of 'doping free sport' (WADA, 2022).

Doping is defined as the occurrence of one or more of the anti-doping rule violations (ADRVs) set forth in the World Anti-Doping Code (WADC)) (WADA, 2021b). The ADRVs can be summarised as the presence of, attempted use of, and possession of prohibited substances; tampering of samples; failing to submit samples; whereabouts failures; trafficking or attempted trafficking; use of prohibited methods; complicity or attempted complicity; association; and retaliation against reporting to authorities. Historically, the ADRVs were predominantly focused on the athlete, and athlete support personnel (e.g. coach, doctors etc.) (Houlihan & Vidar Hanstad, 2019). However, within the updated 2021 WADC, ADRVs now extend to other actors such as administrators and authorities. Despite this, , the majority of the anti-doping research continues to focus on the athletes and support personnel (Chester et al, 2018; Mazanov et al, 2014) as well as sophisticated biological detection methods (Anawalt, 2018; Saugy et al, 2014). In the 2013 World Anti-Doping Agency (WADA) review of progress into doping prevention, it was concluded that important contributors to doping in sport include wider environmental, and political factors (WADA, 2013). This is supported by various studies that suggest doping emerges from a complex web of interactions between sociodemographic, psychosocial, and broader situational and environmental factors (Backhouse et al, 2018; Backhouse et al, 2012; Houlihan & Vidar Hanstad, 2019; Whitaker & Backhouse, 2017). As such, anti-doping research that attempts to

understand only the intrapersonal determinants of doping behaviours, or developing sophisticated biological testing methods will invariably fall short of understanding the broader systemic factors influencing doping.

Doping occurs in a complex and dynamic environment that comprises multiple hierarchical levels of the 'system' that cannot be easily explained or understood (Boardley et al, 2021; Houlihan & Vidar Hanstad, 2019; Houlihan et al., 2019; Malcourant et al, 2015). As such, novel approaches to understanding the systemic influences of doping in sport may help with prevention efforts. One potential approach is to draw upon systems theory-based risk and adverse event analysis methods, which are now recognised as state-of-the-art in safety science (Hulme et al, 2019; Read et al, 2021; Salmon et al., 2020; Waterson et al, 2017).

Using systems-thinking accident causation models to understand doping

Understanding incident causation and preventing future occurrences is the ambition of safety science research (Salmon et al., 2011). Contemporary accident causation models and analysis methods have been designed to identify the systemic influences that create adverse incidents (Zhang et al, 2021). Systems thinking-based accident models consider adverse incidents (in this case committing an ADRV) as an emergent property of the complex interactions between system components (Leveson, 2004). Systems thinking-based accident analysis methods have been critical in demonstrating the systemic influences associated with adverse incidents in safety critical domains such as rail and road safety (Read et al, 2019), defence (Stanton et al, 2019), outdoor recreation (McLean et al., 2021), and aviation (Allison et al, 2017), among others. Given the complexity of the issues faced by Anti-Doping Organisations (ADOs) when attempting to prevent doping in sport (Petroczi & Strauss, 2015), a 'complex systems approach' to understand doping events may be useful in enhancing prevention efforts (Salmon et al., 2021).

Systems thinking-based methods are gathering momentum in sport (Hulme et al, 2018; Salmon et al, 2021). Specific research applications include for the analysis of sports performance (McLean et al., 2019; McLean et al, 2017), sports injury and concussion (Bittencourt et al., 2016; Clacy et al, 2016; Hulme et al, 2017), umpire decision making (Neville, 2017), and sport system design and re-design (McLean et al, 2021; McLean et al, 2021). The benefit of using such methods in sport is the capacity to generate a detailed description of interacting and interdependent relationships between system components that create system behaviour (Salmon & McLean, 2020). It is our view that the application of such methods could enhance our understanding of doping in the Australian football codes and how it can be more effectively managed.

Project Aims and Scope

As part of WADA's commitment to improving evidence based doping prevention strategies through their Social Science Research Grants, this project aimed to answer the question of how the current anti-doping control structure in football codes in Australia can be strengthened.

Project phases

This report describes the findings from the following activities conducted over four phases:

1. Systematic literature review to identify the known contributory factors to doping.
2. Development of a model of the current anti-doping system of the four football codes in Australia using Systems Theoretic Accident Model and Processes (STAMP).
3. Identification of potential control and feedback mechanism inadequacies using the System-Theoretic Process Analysis (STPA).
4. Development of recommendations for new or strengthened controls and feedback mechanisms.

Structure of the Report

The report is structured to provide the reader with an overview of the approach taken and the key findings from each research phase.

Part Two presents the findings from a systematic literature review of the contributing factors to doping from a systems thinking perspective.

Part Three presents the findings from a validated control structure model that was developed based on feedback from subject matter experts (SMEs) in anti-doping in the Australian football codes.

Part Four presents a comprehensive predictive analysis of the different ways in which the current controls and feedback mechanisms could fail.

Part five presents recommendations for new systemic anti-doping control and feedback mechanisms developed though a design process with SMEs from Sport Integrity Australia.

Part Two: Systematic Literature Review of the Contributing Factors to Athlete Doping from a Systems Perspective

Introduction

The purpose of the literature review was to better understand the relationship between the broader sports system and athlete that influences doping. As a first step toward understanding the complex and interrelated set of factors which create the issue of doping in sport, the aim of this systematic review is to identify and synthesise the factors contributing to doping and doping behaviours, attitudes, and beliefs reported in the peer reviewed literature and determine the extent to which they extend beyond the athlete to encapsulate factors across broader sport systems.

Methods

Protocol

The systematic review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 guidelines and flow chart (Page, 2021). PRISMA is a widely used standard that establishes the minimum set of evidence-based reporting guidelines that ensure the literature review process is systematic, comprehensive, transparent, and replicable. For each of the included studies, the following information was extracted:

- the type of study and year publication;
- the country and demographic characteristics (where applicable) of the participants investigated; and
- the factors which were found to contribute to doping, and positive doping behaviours, doping attitudes, or doping beliefs.

The literature search was performed across four databases (Table 1). To ensure that a rigorous standard for the evidence which was included, the systematic review incorporated only databases containing peer-reviewed, published journal articles (PubMed, Scopus, SportDiscuss, and Web Of Science).

Electronic Search

The initial search was conducted on 1st of November 2021. Potentially eligible studies were published between 01 January 1999 and 01 November 2021, inclusive. This date range was chosen as WADA was established in 1999, and to ensure that the review was as comprehensive as possible. The year 1999 and the introduction of WADA represent an obvious starting point as prior to 1999 anti-doping

regulations and sanctions were disparate, with each overarching sporting organisation having differing rules and different sanctions. To ensure compliance with PRISMA guidelines, citation software was used (Endnote X8, Clarivate Analytics, Pennsylvania, United States), and at each stage the inclusion or exclusion of studies was tracked via custom spreadsheet. Justification for the removal of ineligible items was noted during the full-text screen and final selection.

Boolean search terms were generated and used which were derived from the primary research question and adjusted for each specific database (Table 1). These search terms were “anti-doping rule violations” OR “doping” OR “performance-enhancing drugs" AND “sport” OR “sport performance”. The specific search terms ensured that all relevant studies were included in the initial search before being refined. Results of the initial search and following removal of duplicate entries is presented below (Table 1).

Table 1. Keywords, initial search results, and search results following automated and manual duplicate removal for each database searched.

Database	Initial search results	Search results following duplicate removal
PubMed	595	478
Scopus	508	484
SportDiscus	3656	3222
Web of Science	2142	1634
Total	6901	5818

Eligibility Criteria

The authors defined inclusion and exclusion criteria *a priori* to support the identification of studies relevant to the research aims and rationale. Accordingly, as this review aimed to identify contributory factors to doping and positive doping behaviours, attitudes, and beliefs, the search strategy and scope of inclusion was deliberately broad to capture factors at both systemic (e.g., team environment, medical, regulatory/policy) and the individual athlete levels of doping.

Included studies complied with the following criteria:

i. The study investigated doping or doping behaviours/attitudes/beliefs amongst athletes.

ii. The study primarily focused on the individual, situational, environmental, and/or systemic factors and characteristics that contribute to doping or behaviours/attitudes/beliefs amongst athletes.

iii. The study was published in the peer reviewed literature and had full-text versions which were available in English.

Studies were excluded based on the following criteria:

i. The study focused on doping prevalence, or the development, implementation, and/or adoption of specific doping analytical techniques.

ii. The study examined specific dietary supplements/ergogenic aids and discuss the doping potential of these substances or adulterants within these substances.

iii. The study focused on individual-athlete psychological, socioeconomic, or demographic factors in the absence of situational, environmental, and/or systemic factors and characteristics.

iv. The study focused on aesthetic athletes (e.g., bodybuilders) or the general gym-attending public not subject to the WADA code.

v. The study focused on protective factors against doping (e.g., education, enforcement, religion).

vi. The study was an opinion paper, a theoretical or simulation-type paper, not peer reviewed (e.g. was published as conference article or in the grey literature), and/or only available in languages other than English.

Following the initial search and removal of duplicates (Table 1), a search of study titles and abstracts from all retrieved studies was performed against the eligibility criteria (see above). Following this, the full-text of the remaining studies were screened. The rationale for the removal of studies that were removed during the full-text screen was noted (Figure 2).

Mapping Contributory Factors onto Rasmussen's Risk Management Framework (RMF)

Rasmussen's (1997) Risk Management Framework (RMF), (Rasmussen, 1997) and associated ActorMap and AcciMap methods are state-of-the-art accident analysis theory and methods, and have been used extensively in safety critical domains (Hulme et al, 2019; Salmon et al, 2020; Waterson et al, 2017) For example, the RMF and AcciMap method have been used to better understand the

systemic influences on cycling crash contributory factors (Salmon et al, 2022), community rugby concussions (Clacy et al, 2019), food supply contamination (Cassano-Piche et al, 2009; Nayak & Waterson, 2016), and outdoor activity incidents (McLean et al, 2022; Salmon et al, 2017). According to Rasmussen's RMF, complex work systems consist of various hierarchical levels (e.g., governments, regulatory bodies, organisations, medical staff, management, athletes, and equipment and environment), which each containing stakeholders and actors who share responsibility for the performance of the system. Therefore, decisions and actions which are (or are not) taken by actors at all levels within a systems hierarchy influence the overall behaviour of a system. The RMF also describes the critical need for communication and feedback across the system as well various pressures (e.g., financial, workload, performance) that influence behaviour and create migration of practices, both at the systems level and across all levels of the system. As such, the RMF suggests that for anti-doping, the act of doping and ADRVs is influenced by the decisions and actions of multiple actors within the system and not just the athletes and support staff committing ADVRs. Further, stakeholders at all levels of the system operate under various pressures; for example, athletes and coaches often perform under financial and performance pressures as do sports governing bodies and anti-doping agencies. According to Rasmussen (1997), poor communication and migration of practices will combine to create doping and ADRVs. The key implication is that it is not possible to understand doping by focusing on the athlete using the banned method or substance only. Rather, it is the decisions and actions of actors at all levels within the broader doping/anti-doping system that contribute to doping and are therefore of interest. Given this assertion, and two recent WADA-funded reviews which have explored the psychological and behavioural contributing factors to doping (Backhouse et al, 2016; Ntoumanis et al, 2014) these within individual factors were not considered unless there was interaction with other actors within the RMF.

In the current review, the RMF was modified to include an International level which is in line with prior work in road safety (McIlroy et al, 2019), healthcare (Salmon et al, 2021), running injury (Hulme et al, 2017), and rugby (Clacy et al, 2019) to fit with the anti-doping context. A truncated RMF example is presented in Figure 1, along with examples of actors at each of the hierarchical levels involved in the 'anti-doping system':

1. *International influences*. The highest level of the framework includes international bodies who have an influence on doping/anti-doping in sport, such as the World Anti-Doping Agency, International governing bodies (e.g., World Rugby, FIFA, FINA), and the International Olympic Committee (IOC).
2. *Government and government bodies*. The second level includes the government and other governing bodies who have a role to play in doping/anti-doping within sport, including the Therapeutic Goods Administration, national governing bodies, and national governments.
3. *Regulatory bodies and associations*. The third level includes regulatory bodies and associations who have a role to play in doping/anti-doping within sport, including the media (legacy and social), insurers, advocacy groups, and research groups.
4. *Teams and organisations*. The fourth level includes the team and organisational actors such as sporting teams/organisations, players union/associations, and sponsors.
5. *Direct supervisors, management, medical and performance personnel*. The fifth level includes actors whose role is to act in a supervisory manner to the athletes, including team doctors, sports scientists, dieticians and nutritionists, and team management.
6. *Athlete, teammates, and opponents*. The sixth level of the framework includes the training and competition situational environment and the decisions, actions, and characteristics of different actors within that environment (e.g., athletes, their opponents, teammates, and fans).
7. *Equipment, substances, methods, and environment*. The lowest level of the framework includes the immediate doping environment along with banned substances, methods, and whereabouts violations.

	Example stakeholders/actors
International influences	World Anti-Doping Agency International governing bodies International Olympic Committee
Governments and governing bodies	Therapeutic Goods Administration National governing bodies National governments
Regulatory bodies and associations	Media Insurers Advocacy groups Research groups
Teams and organisations	Sporting organisations Players union/association Sponsors
Direct supervisors, management, medical and performance personnel	Team doctor Sports scientist Dietician/Nutritionist Physiotherapist
Athlete, teammates, and opponents	Athletes Opponents Teammates Fans
Equipment, substances, methods, and testing environment	Banned substances Banned methods Whereabouts violations Doping control

Figure 1. Rasmussen's Risk Management Framework (RMF) example in sport which is adapted from prior work in rugby (Clacy et al., 2019) to represent the doping/anti-doping in sport context.

Identification of Contributory Factors

Contributory factors are defined as factors "that, if it had not occurred or existed at the relevant time, then either the occurrence would probably not have occurred, adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or another contributing safety factor would probably not have occurred or existed"(ABS, 2008) Contributory factors were identified based on whether they increased or were associated with an increase in doping occurrences, the risk or likelihood of doping, or doping behaviours, doping attitudes, or doping beliefs. Contributory factors were extracted from the included articles and placed at the relevant level of the RMF with factors grouped thematically, where appropriate (Salmon et al, 2022). For example, contributory factors related to the coach and athlete relationship such as coach to athlete confrontation efficacy and coaching style (Boardley et al, 2019; Chen et al, 2017), were placed at the 'Direct supervisors, management, medical and performance personnel' and 'Athlete, teammates, and opponents' levels of the RMF, respectively (Figure 1). Actors and factors which were identified as contributing to doping at the different levels of the RMF were mapped to produce an ActorMap and AcciMap, respectively. Relationships between the actors from across the broader system and the athlete were included in the ActorMap to represent the number of included articles identifying each given relationship. The relationships were extracted from the included studies when they were identified either quantitatively or qualitatively. For example, if a study identified that sponsorship influenced athlete doping, a link was made on the ActorMap between these two actors and their respective levels of the RMF, with the number between these two actors on the ActorMap reflecting the number of studies which identified this relationship.

Given the breadth of types of analysis used in the included studies (and associated data [e.g., surveys, case studies, interviews]), the identified relationship did not have to achieve statistical significance or any effect size threshold (e.g., Cohen's d) for it to be included.

Results

Full-text selection

The search across the four databases yielded 6901 records, with 5818 remaining following duplicate removal. The titles and abstracts of these records were assessed against the eligibility criteria, and 370 records remained. Based on the full-text screening of these records, 317 were removed as they did not meet the criteria for inclusion (Figure 2). Thereafter 56 studies remained and these were included in the final synthesis (Appendix 1) (Aubel et al, 2018, 2019; Aubel & Ohl, 2014; Backhouse et al, 2013; Bae et al, 2017; Barkoukis et al, 2015; Barkoukis et al, 2020; Bilard et al, 2011; Bloodworth &

McNamee, 2010; Boardley et al, 2015; Boardley et al, 2019; Chan et al, 2014; Devcic et al, 2018; Didymus & Backhouse, 2020; Donovan et al, 2002; Erickson et al, 2015; Fincoeur et al, 2018; Garcia-Grimau et al, 2021; Hanstad & Waddington, 2009; Harcourt et al, 2014; Harris et al, 2021; Hauw & Mohamed, 2015; Henning et al, 2021; Hurst et al, 2019; Hurst et al, 2021; Huybers & Mazanov, 2012; Jalleh et al, 2014; Kabiri et al, 2021; Kabiri et al, 2020; Kegelaers et al, 2018; Kirby et al, 2011; Kondric et al, 2011; Lentillon-Kaestner, 2013; Lentillon-Kaestner & Carstairs, 2010; Lentillon-Kaestner et al, 2012; Liposek et al, 2018; Lucidi et al, 2013; Matosic et al, 2016; Mazanov & Huybers, 2010; Mazanov et al, 2011; Morente-Sanchez et al, 2013; Murray et al, 2013; Nicholls et al, 2020; Nicholls et al, 2014; Ntoumanis et al, 2017; Pappa & Kennedy, 2013; Petrou et al; Sekulic et al, 2014; Smith & Stavros, 2020; Smith, 2017; Sullivan & Razavi, 2017; Vakhitova & Bell, 2018; Whitaker & Backhouse, 2017; Whitaker et al, 2014; Zucchetti et al, 2015; Zuosong et al, 2017).

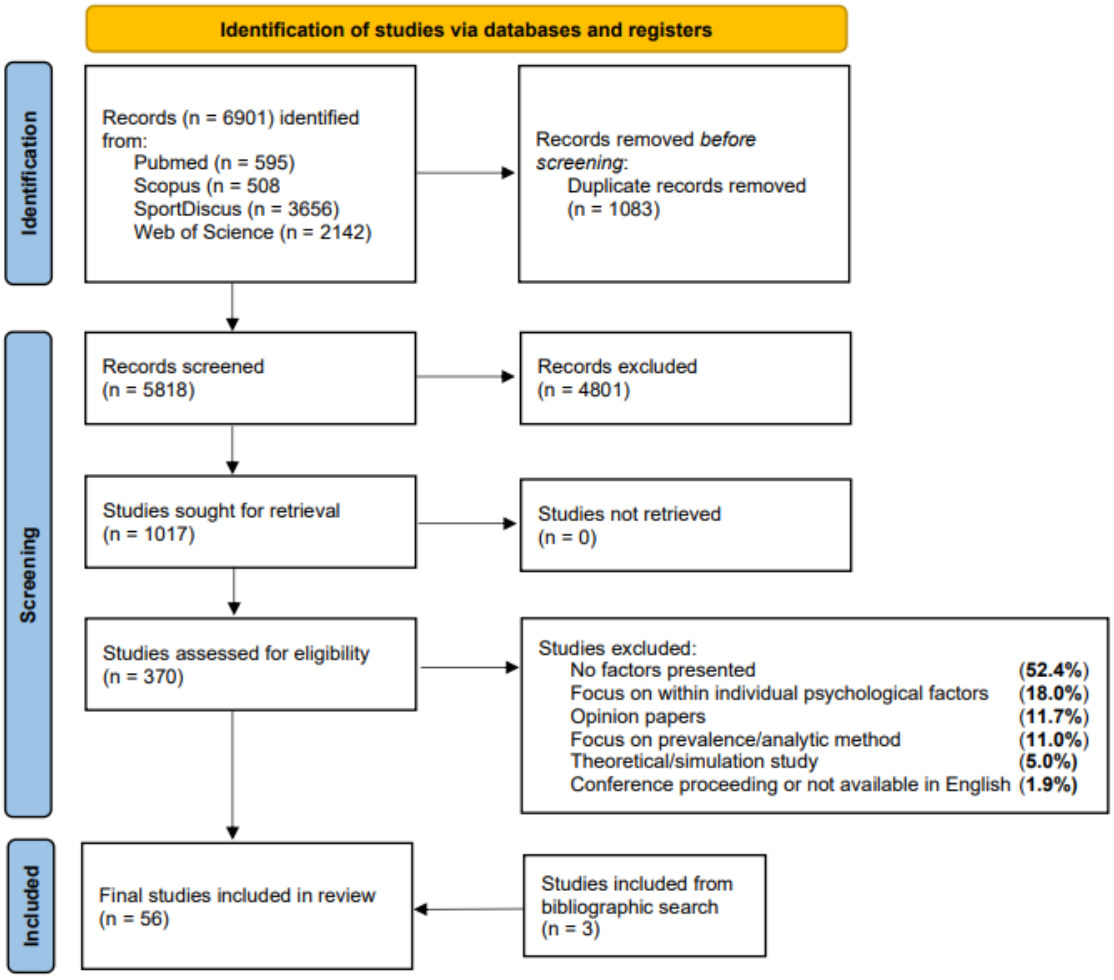

Figure 2. PRISMA 2020 study selection flowchart.

Publication information

56 articles, published between 2002-2021, were included in the final synthesis (Appendix 1). In total, 53 of the included studies (95%) used an applied approach (e.g., surveys, interviews, focus groups, or mixed methods) to data collection, while 3 of the included studies (5%) were relevent reviews. Of the applied studies, 26 studies used a survey approach (49%), while 15 studies (28%) collected data via interviews (semi-structured or otherwise), 2 (4%) used focus groups, 1 (2%) was a case study, and the remaining 10 studies (19%) either used a mix of survey and interview methods and/or other approaches to data collection (eg.., analysis of athlete transcripts, database analysis, statements, and/or biographies) (Supplementary Table 1).

Participant information

The included studies primarily examined male and female athletes or players as their participants, although coaches, doctors, sports scientists, strength and conditioning coaches, physiotherapists, dieticians, doping 'experts', and researchers were also sampled (Appendix 1). These participants were drawn from a range of Olympic and non-Olympic professional and amateur sports including (but not limited to): track and field, soccer (football), cycling, rugby union, rugby league, mixed-martial arts (MMA), rowing, hockey, gymnastics, wrestling, volleyball, basketball, handball, and water polo (see Supplementary Table 1 for further details).

Geographical makeup

Figure 3 shows the count of the studies which included participants from a specific country. The United Kingom (12 studies), Australia (11 studies), and the United States of America (10 studies) were the largest source of participants (Figure 3).

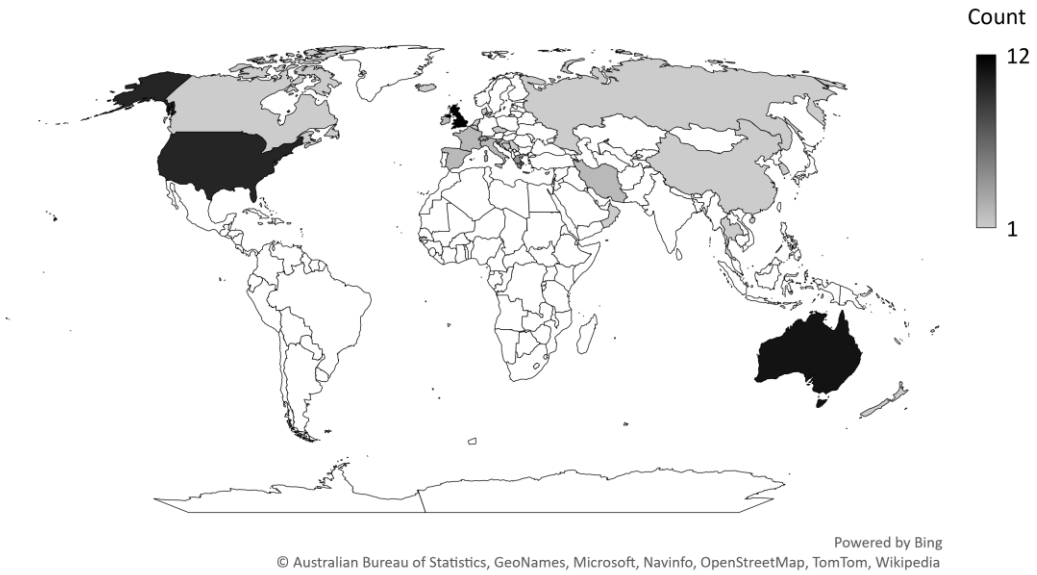

Figure 3. The geographical origin for the participants of the included studies with the colour gradient reflecting the count of the included studies (range 1 – 12 studies).

Actors and Contributory Factors

An ActorMap showing the actors and organisations identified as having an influence on instances of doping is presented in Figure 4. Actors were identified across all levels of the sport system hierarchy, with the most populated levels including the "Athlete, teammates and opponents' and 'Direct supervisors, management, medical, and performance personnel' levels. Given the central role that the athlete plays in doping, the identified actors predominantly interact directly with the athlete (i.e., they influence the athletes' doping behaviours and/or doping attitudes and beliefs) (Figure 4).

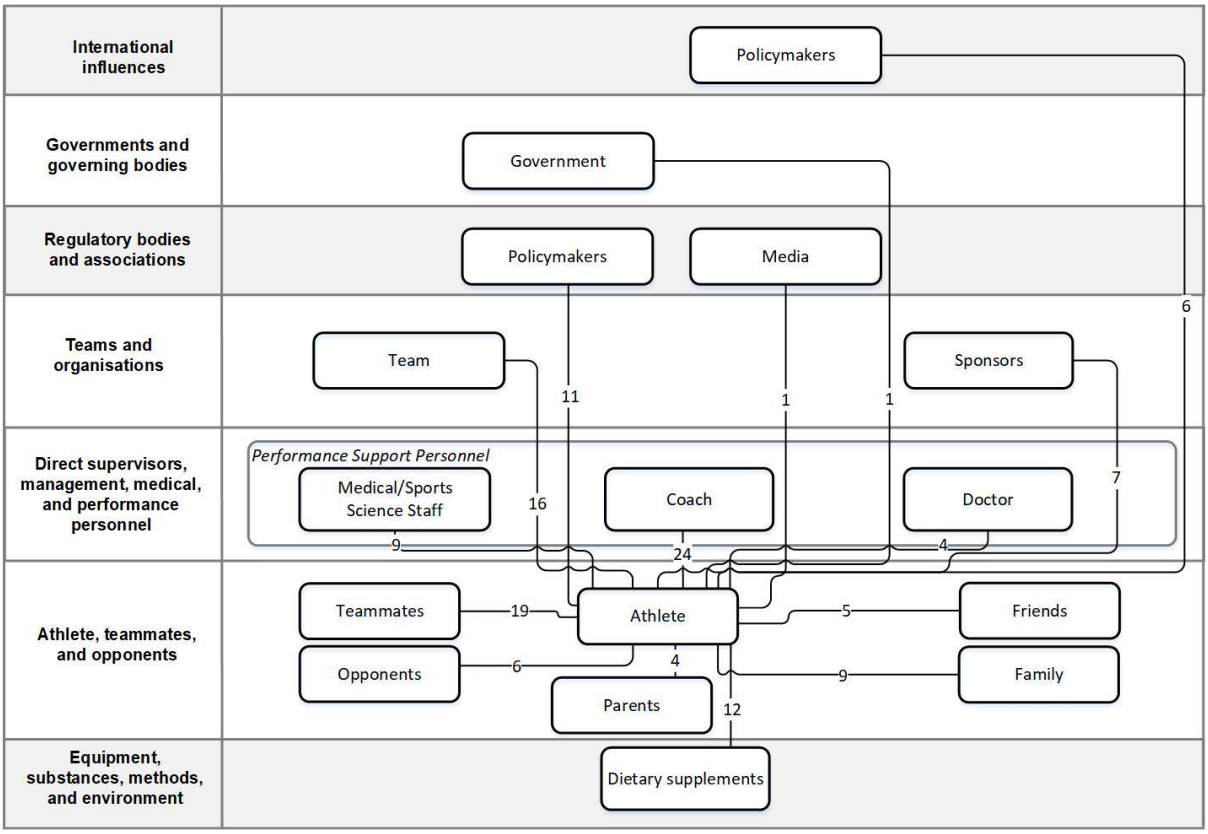

Figure 4. Relationships between actors mapped onto an adapted version of Rasmussen's Risk Management Framework (RMF) ActorMap. Lines connecting two nodes represents a described relationship between the contributory factors and numbers overlaid onto the line represent the number of studies to describe the relationship.

The contributory factors which are reported in the literature as having an influence on doping were mapped onto the RMF to produce an AcciMap (Figure 5). The identified contributory factors in Figure 5 are expanded on in further detail in Appendix 2. As shown in Figure 5, contributory factors were identified at all levels of the sport system hierarchy, with the most populated levels including the 'Athlete, teammates and opponents', 'Direct supervisors, management, medical, and performance personnel', and 'Teams and organisations' levels.

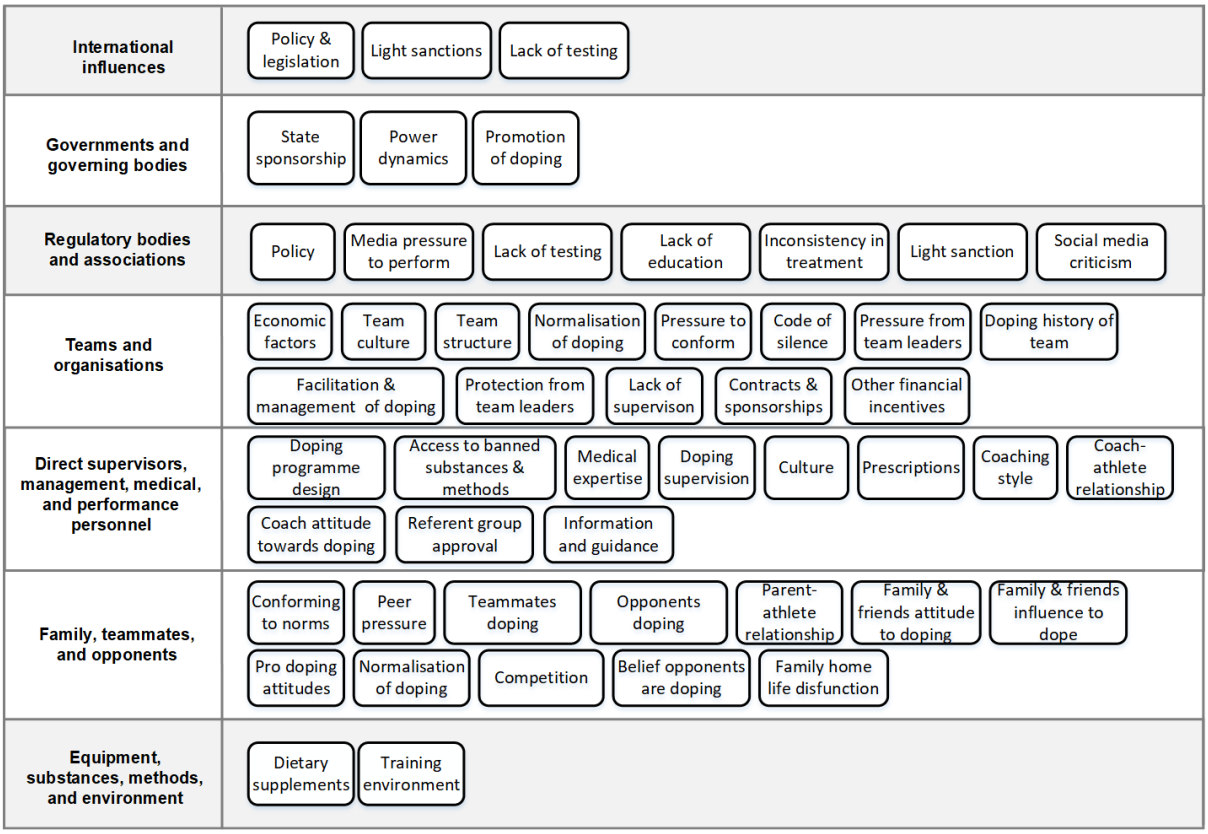

Figure 5. Identified contributory factors mapped onto an adapted version of Rasmussen's Risk Management Framework (RMF) AcciMap. See Supplementary Table 2 for expanded details on these factors.

Discussion

This review sought to identify the known actors and contributory factors that influence doping and doping behaviours, attitudes, and beliefs in sport. The intention was to determine the extent to which the current knowledge base extends beyond athletes to consider the broader sport system influences. The findings show that there are contributory factors to doping behaviours and attitudes at each level of sport systems from international influences and government levels, through to the equipment and substances at the lower levels of the system. The coach and coach-athlete relationship are one particular aspect which seems to have a large influence on the doping 'worldview' of athletes. A further finding was the current deterence-detection system appears to lack legitimacy to athletes as they percieve the penalties are low relative to the potential rewards on offer for doping-related improvements in performance. Given that the current anti-doping approach has had varied success in doping prevelence, research examining interventions to improve the anti-doping system should focus their efforts on high level system leverage points which have the potential to ellicit large scale systemic change. The findings have implications for athlete health, anti-doping authorities and policy makers as they seek to to minimise and, where possible, eliminate doping from

sport. Given the complex, emergent nature of doping in the wider sporting system, future research investigating doping and anti-doping would benefit from the adoption of complex systems thinking methods.

Part Three: Development of a STAMP control structure model of the anti-doping system in Australian Football Codes'

Introduction

There is no current model of the structure of the anti-doping system in Australia that includes a. the actors and organisations residing at the different hierarchical levels, b. the system of controls used to prevent doping, and c. the feedback mechanisms that stakeholders use to understand how successful doping prevention activities are s. One modelling approach that is used to describe stakeholders, controls, and feedback mechanisms is the Systems Theoretic Accident Model and Processes (STAMP) (Leveson, 2004) (Figure 1). STAMP is grounded on the observation that single component failures in isolation are rarely the cause of incidents (Leveson, 2004). Control theory forms the theoretical basis for STAMP and promotes the view that incidents or adverse behaviours result from inadequate control structures and deficiencies surrounding the enforcement of safety-related constraints (Leveson, 2004). In the doping in sport context, this would suggest that doping occurs when emergent properties relating to doping across the sport system are not adequately controlled. Further, the STAMP model suggests that doping prevention requires a network of controls and feedback mechanisms across the overall sport system, not just around coaches and athletes. Underpinned by these assertions, the associated STAMP control structure modelling method provides a useful approach to explore current doping prevention stakeholders, controls, and feedback mechanisms, and to identify opportunities where they can be strengthened or where new controls and feedback mechanisms are required (Salmon et al, 2022).

The aim of this study was to develop and validate a STAMP control structure model of the current anti-doping system in four football codes in Australia. This involved using the STAMP control structure to identify the actors and control and feedback mechanisms that are currently used to manage doping across the four codes in Australia. The football codes were chosen based on their popularity, and due to the fact that they represent approximately one third (32%) of current sanctioned athletes and support personnel in Australia (13 of 41 sanctions across all sports) (Sport Integrity Australia, 2022).

Methods

Design

The current study was designed to develop and validate a STAMP control structure model (Figure 6) of the anti-doping system for four football codes in Australia (Football, Rugby, Rugby League, and

Australian Rules Football). The study included a multi-phase approach to develop and validate a control structure model of the football codes (Figure 7) using STAMP. As shown in Figure 7, the control structure model was developed based on data derived from multiple sources, including anti-doping stakeholder websites, policy documents, anti-doping strategies, peer reviewed literature, and three rounds of subject matter expert (SME) review.

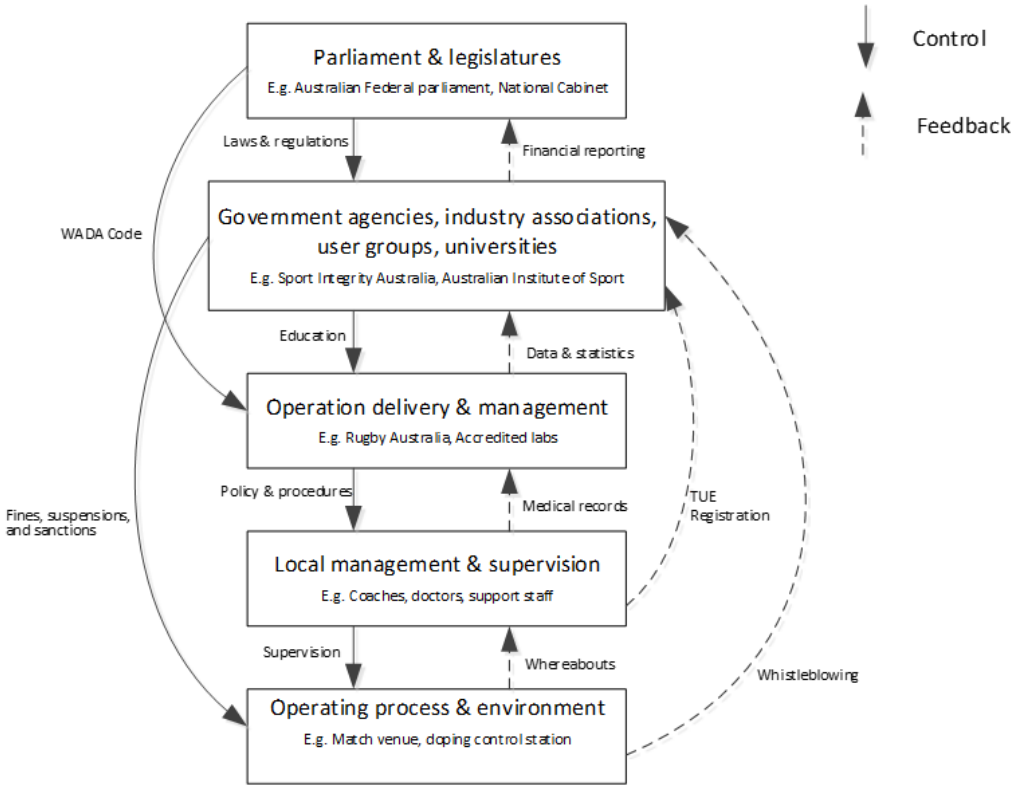

Figure 6. Conceptual control structure of an Australian anti-doping system adapted from (Leveson, 2004). Controls (solid arrows) are enforced down through the system, and feedback (broken arrows) is communicated back up the system. Control and feedback mechanisms are passed between levels and across levels. Each level therefore includes a description of the relevant agents and organisations that play a role in system design or operation. Control and feedback mechanisms are included to show what controls are enacted down the hierarchy and what information about the status of the system is sent back up the hierarchy.

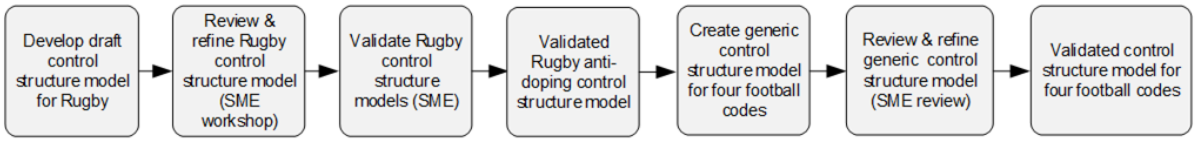

Figure 7. Control structure model development and validation process.

Participants

Eighteen participants (9 Female, 9 male) participated in the current study as anti-doping SMEs. Participants had a mean age of (40.1 ± 8.8 years) and held positions at the World Anti-Doping Agency, Sport Integrity Australia, National Sporting Organisations, one professional rugby club, Universities, and the Queensland Academy of Sport. Participants held a variety of roles within anti-doping, including high level roles of Directors, Assistant Directors, and Chief Science Officers at national and international anti-doping organisations, and specifically in anti-doping testing, football code integrity and medical programs, sports operations, anti-doping research, sport science, medical advisors, players associations, education officers, intelligence, and therapeutic use exemptions. Participants mean experience in their respective roles was 5.4 ± 4.4 years. Demographic data presented are for 14 participants, four opted out of providing age and experience, but included current roles.

Procedure

STAMP model development

A draft control structure model of one football code (Rugby) was developed by the research team based on publicly available sources, including anti-doping stakeholder websites, anti-doping policy documents, anti-doping strategies, media, and peer reviewed literature. To accurately reflect the anti-doping system, the STAMP model was adapted to include an international level, which is commonplace in other STAMP analyses (Hulme et al., 2017; Read et al., 2019). An SME workshop to review and refine the control structure model was conducted via video conferencing software (Zoom). The workshop was facilitated by the research team who have extensive experience in conducting workshops for complex system model development and validation purposes (McLean et al., 2021; Salmon et al, 2016). The draft control structure model and instructions on how to interpret the model were sent to the participants two weeks prior to the workshop. During the workshop, participants were asked to review each of the hierarchical levels of the control structure model to determine the accuracy of the actors and organisations included in the model, and to identify any missing actors and

organisations. This involved starting at the international level of the control structure and working down through the levels. Participants were then asked to review each of the controls and feedback mechanisms included in the model to determine their accuracy and to identify any missing control and feedback mechanisms. This involved first starting at the top of the control structure and working down through the control mechanisms, and then back up through the feedback mechanisms. The workshop was recorded, two of the research team (SM and MN) independently reviewed the recording and extracted the revisions proposed by the participants. Three authors (SM, MN, PS) then took part in a workshop in which they refined the model based on the feedback from the independent reviews. The refined model was sent back out to the workshop participants via email for additional comments, and further revisions were made resulting in a final validated control structure model of the Rugby anti-doping system in Australia.

Generic football code model development

The validated Rugby anti-doping control structure model was then used as the basis for a generic control structure model to represent the anti-doping system for the four Australian football codes. The research team adapted the Rugby control structure model to include Football, Rugby League, and AFL. This process involved modifying organisations and actors to be generic across the codes, for example, the organisation 'World Rugby' was replaced with 'International governing bodies', and 'Rugby Australia' was replaced with 'National governing bodies' and so on throughout the model. The generic football codes control structure model was reviewed by SMEs from the governing body for the integrity of sport in Australia, and representatives from NSO's of Football, Rugby League, and AFL. The SMEs were asked to review the generic control structure model to determine the accuracy and appropriateness of the actors and organisations, and the control and feedback. The generic football code control structure model was refined based on the comments provided by the participants, resulting in a complete and valid control structure model of the anti-doping system for four football codes in Australia.

Results

Model validation

The STAMP model validation process is presented in Figure 8. Actors, controls and feedback mechanisms were added or removed during model refinement based on SME feedback.

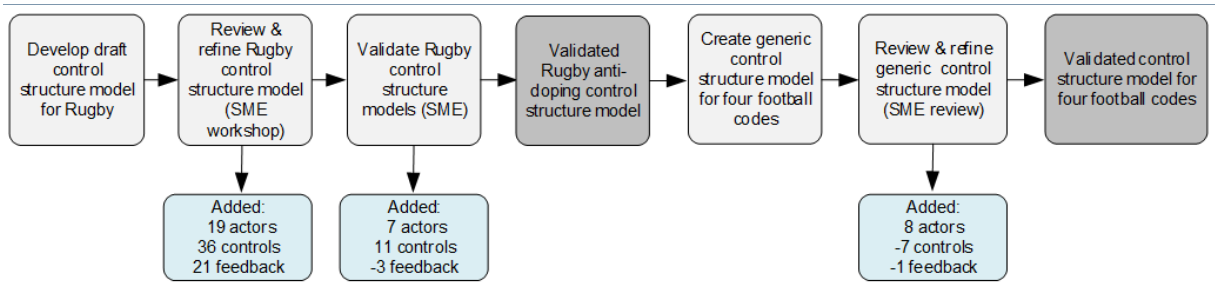

Figure 8. The STAMP model validation process showing the revisions (blue shaded nodes) to the actors, control and feedback mechanisms proposed by the SMEs at review each phase. The negative symbol (-) indicates the removal of model components.

STAMP model

The final control structure model is presented in Figure 9. The model shows the actors at each level, as well as the control mechanisms (labels shown adjacent to the solid arrows propagating down through the hierarchy) and feedback mechanisms (labels adjacent to the dashed arrows propagating up through the hierarchy). In total, the STAMP model includes 117 actors, 107 control mechanisms, and 73 feedback mechanisms that are responsible for the performance of the anti-doping system in the football codes in Australia.

At the international level, 19 actors were identified that influence actors at all levels of the Australian anti-doping system hierarchy through multiple control mechanisms. The control mechanisms include the WADC, coordination and agreements, international standards and guidelines, WADA ethics and legal, compliance reports, education requirements, WADA laboratory accreditation, substance information, research funding, compliance monitoring, among others (Figure 9). Feedback mechanisms that are used by the anti-doping system to provide information to the international actors include therapeutic use exemptions (TUE) outcomes, sanction and statistics data, compliance outcomes, research reports and findings, education attendance data and statistics, among others (Figure 9).

At the Parliament and Legislatures level, five actors were identified who impose controls on level 2 actors such as strategy, policy and action plans, laws, rules and regulations, funding and resource allocation, political objectives (Figure 9). The feedback provided to the Parliament and Legislature includes, government reports, financial reporting, sanction data and statistics, advocacy, senate estimate briefings, among other (Figure 9).

At the Government agencies, industry associations, user groups, courts, and universities level, 27 actors were identified that impose controls on level 3, 4 and 5 actors and include legal penalties,

quality standards and assurances, compliance monitoring, substance information, education, TUE approvals, accreditation, sample collection manual, operating procedures, among others (Figure 9). Feedback to this level from levels 3, 4 and 5 include integrity complaints, audit results, TUE applications, education attendance data and statistics, financial reporting, whereabouts, research reports and findings, laboratory reporting, research proposals, whistleblowing, among others (Figure 9).

At the Operational delivery and management level, 19 actors were identified that impose controls on levels 4 and 5 and include, training policies and procedures, training, education, fines suspensions and sanctions, rules and regulations, accreditation/licensing, enforcement planning and strategies, among others. Feedback to this level from levels 4 and 5 include TUE applications, medical records, supplement register, education auditing, public opinion among others (Figure 9).

At the local management and supervision level, 23 actors were identified that impose controls on the operating process and environment. Identified controls include, doping control, supervision, education, medical testing, surveillance, and audits, among other. Feedback from the operating process and environment include, integrity complaints, education attendance data and statistics, evaluations, and social controls.

At the operating process and environment level, 25 components and actors were identified including sample collection equipment, event venues, technologies, and the act of ADRVs, among others. Feedback from this level is passed onto levels 4, 3, 2 and the international context and include, whereabouts, policy complaints, whistle blowing, TUE applications, among others (Figure 9).

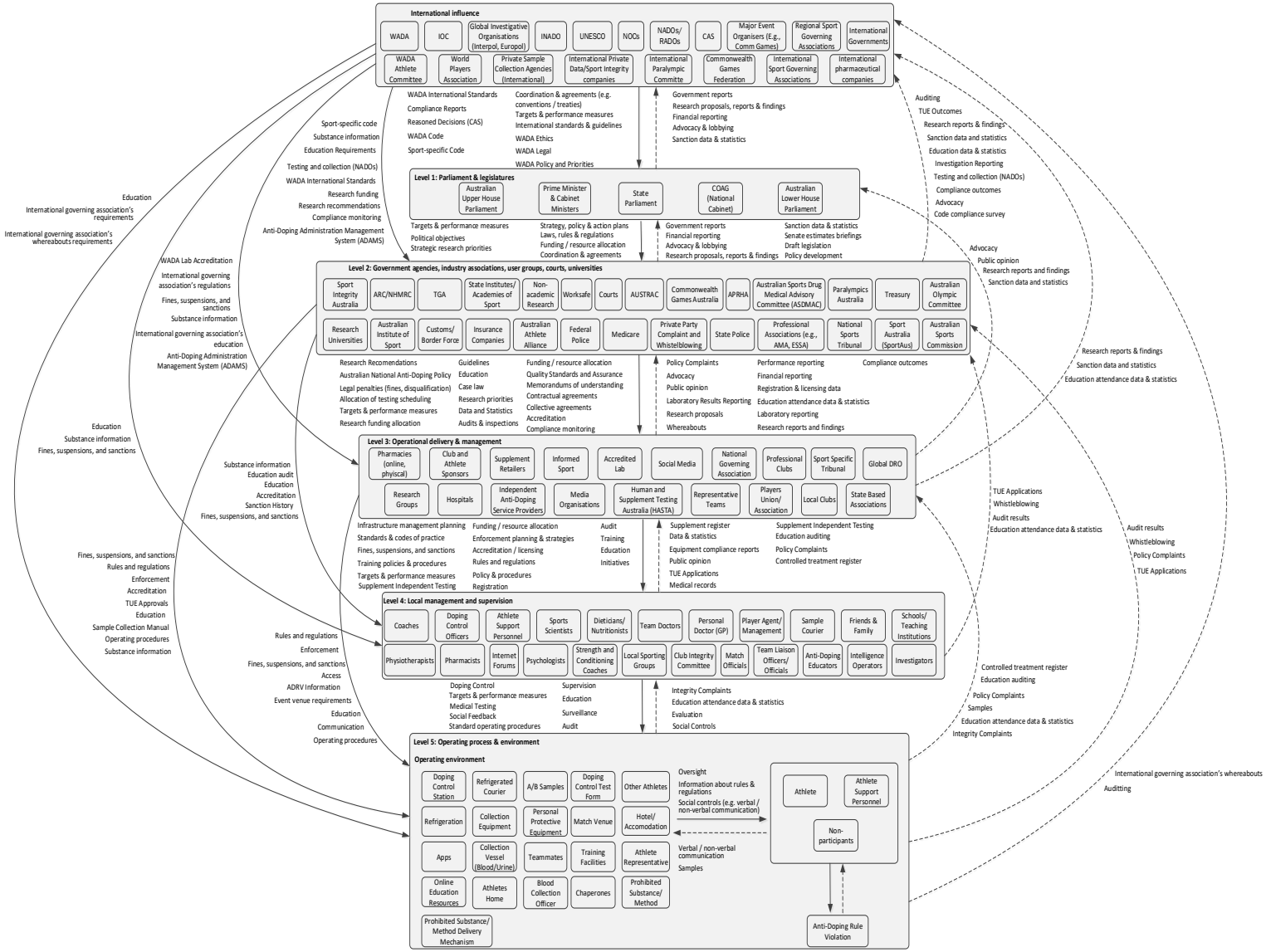
International influence
WADA
IOC
Global Investigative Organisations (Interpol, Europol)
INADO
UNESCO
NOCs
NADOs/ RADOs
CAS
Major Event Organisers (E.g., Comm Games)
Regional Sport Governing Associations
International Governments
WADA Athlete Committee
World Players Association
Private Sample Collection Agencies (International)
International Private Data/Sport Integrity companies
International Paralympic Committe
Commonwealth Games Federation
International Sport Governing Associations
International pharmaceutical companies
WADA International Standards
Compliance Reports
Reasoned Decisions (CAS)
WADA Code
Sport-specific Code
Coordination & agreements (e.g. conventions / treaties)
Targets & performance measures
International standards & guidelines
WADA Ethics
WADA Legal
WADA Policy and Priorities
Government reports
Research proposals, reports & findings
Financial reporting
Advocacy & lobbying
Sanction data & statistics
Auditing
TUE Outcomes
Research reports & findings
Sanction data and statistics
Education data & statistics
Investigation Reporting
Testing and collection (NADOs)
Compliance outcomes
Advocacy
Code compliance survey
Sport-specific code
Substance information
Education Requirements
Testing and collection (NADOs)
WADA International Standards
Research funding
Research recommendations
Compliance monitoring
Anti-Doping Administration Management System (ADAMS)
Education
International governing association's requirements
International governing association's whereabouts requirements
Level 1: Parliament & legislatures
Australian Upper House Parliament
Prime Minister & Cabinet Ministers
State Parliament
COAG (National Cabinet)
Australian Lower House Parliament
Targets & performance measures
Political objectives
Strategic research priorities
Strategy, policy & action plans
Laws, rules & regulations
Funding / resource allocation
Coordination & agreements
Government reports
Financial reporting
Advocacy & lobbying
Research proposals, reports & findings
Sanction data & statistics
Senate estimates briefings
Draft legislation
Policy development
Advocacy
Public opinion
Research reports and findings
Sanction data and statistics
WADA Lab Accreditation
International governing association's regulations
Fines, suspensions, and sanctions
Substance information
International governing association's education
Anti-Doping Administration Management System (ADAMS)
Level 2: Government agencies, industry associations, user groups, courts, universities
Sport Integrity Australia
ARC/NHMRC
TGA
State Institutes/ Academies of Sport
Non-academic Research
Worksafe
Courts
AUSTRAC
Commonwealth Games Australia
APRHA
Australian Sports Drug Medical Advisory Committee (ASDMAC)
Paralympics Australia
Treasury
Australian Olympic Committee
Research Universities
Australian Institute of Sport
Customs/ Border Force
Insurance Companies
Australian Athlete Alliance
Federal Police
Medicare
Private Party Complaint and Whistleblowing
State Police
Professional Associations (e.g., AMA, ESSA)
National Sports Tribunal
Sport Australia (SportAus)
Australian Sports Commission
Research Recomendations
Australian National Anti-Doping Policy
Legal penalties (fines, disqualification)
Allocation of testing scheduling
Targets & performance measures
Research funding allocation
Guidelines
Education
Case law
Research priorities
Data and Statistics
Audits & inspections
Funding / resource allocation
Quality Standards and Assurance
Memorandums of understanding
Contractual agreements
Collective agreements
Accreditation
Compliance monitoring
Policy Complaints
Advocacy
Public opinion
Laboratory Results Reporting
Research proposals
Whereabouts
Performance reporting
Financial reporting
Registration & licensing data
Education attendance data & statistics
Laboratory reporting
Research reports and findings
Compliance outcomes
Research reports & findings
Sanction data and statistics
Education attendance data & statistics
Education
Substance information
Fines, suspensions, and sanctions
Substance information
Education audit
Education
Accreditation
Sanction History
Fines, suspensions, and sanctions
Level 3: Operational delivery & management
Pharmacies (online, phyiscal)
Club and Athlete Sponsors
Supplement Retailers
Informed Sport
Accredited Lab
Social Media
National Governing Association
Professional Clubs
Sport Specific Tribunal
Global DRO
Research Groups
Hospitals
Independent Anti-Doping Service Providers
Media Organisations
Human and Supplement Testing Australia (HASTA)
Representative Teams
Players Union/ Association
Local Clubs
State Based Associations
Infrastructure management planning
Standards & codes of practice
Fines, suspensions, and sanctions
Training policies & procedures
Targets & performance measures
Supplement Independent Testing
Funding / resource allocation
Enforcement planning & strategies
Accreditation / licensing
Rules and regulations
Policy & procedures
Registration
Audit
Training
Education
Initiatives
Supplement register
Data & statistics
Equipment compliance reports
Public opinion
TUE Applications
Medical records
Supplement Independent Testing
Education auditing
Policy Complaints
Controlled treatment register
TUE Applications
Whistleblowing
Audit results
Education attendance data & statistics
Audit results
Whistleblowing
Policy Complaints
TUE Applications
Fines, suspensions, and sanctions
Rules and regulations
Enforcement
Accreditation
TUE Approvals
Education
Sample Collection Manual
Operating procedures
Substance information
Level 4: Local management and supervision
Coaches
Doping Control Officers
Athlete Support Personnel
Sports Scientists
Dieticians/ Nutritionists
Team Doctors
Personal Doctor (GP)
Player Agent/ Management
Sample Courier
Friends & Family
Schools/ Teaching Institutions
Physiotherapists
Pharmacists
Internet Forums
Psychologists
Strength and Conditioning Coaches
Local Sporting Groups
Club Integrity Committee
Match Officials
Team Liaison Officers/ Officials
Anti-Doping Educators
Intelligence Operators
Investigators
Rules and regulations
Enforcement
Fines, suspensions, and sanctions
Access
ADRV Information
Event venue requirements
Education
Communication
Operating procedures
Doping Control
Targets & performance measures
Medical Testing
Social Feedback
Standard operating procedures
Supervision
Education
Surveillance
Audit
Integrity Complaints
Education attendance data & statistics
Evaluation
Social Controls
Controlled treatment register
Education auditing
Policy Complaints
Samples
Education attendance data & statistics
Integrity Complaints
Level 5: Operating process & environment
Operating environment
Doping Control Station
Refrigerated Courier
A/B Samples
Doping Control Test Form
Other Athletes
Refrigeration
Collection Equipment
Personal Protective Equipment
Match Venue
Hotel/ Accomodation
Apps
Collection Vessel (Blood/Urine)
Teammates
Training Facilities
Athlete Representative
Online Education Resources
Athletes Home
Blood Collection Officer
Chaperones
Prohibited Substance/ Method
Prohibited Substance/ Method Delivery Mechanism
Oversight
Information about rules & regulations
Social controls (e.g. verbal / non-verbal communication)
Verbal / non-verbal communication
Samples
Athlete
Athlete Support Personnel
Non-participants
Anti-Doping Rule Violation
International governing association's whereabouts
Auditing

Figure 9. The validated anti-doping control structure for four football codes in Australia (Rugby, AFL, football, and rugby league).

Discussion

Anti-doping as a complex system

The football code anti-doping control structure model demonstrates the complexity of the anti-doping system through the specification of numerous actors that share responsibility for anti-doping. The conceptualisation of the anti-doping system as a complex sociotechnical system supports assertions that doping activities are emergent properties of the broader sports system (Houlihan & Vidar Hanstad, 2019). The findings support previous research indicating that anti-doping activities should move beyond reducing the problem of doping to a single actor, action, or piece of legislature and consider the role of the broader doping prevention system, its interrelated components, and resulting emergent properties (Houlihan & Vidar Hanstad, 2019). Contemporary safety science research has demonstrated that adverse incidents (e.g. doping) are caused by interacting networks of contributory factors brought about by decision and actions from actors across the system hierarchy (Salmon et al, 2020). Systems thinking-based accident models are useful in that they are designed to help identify interacting systemic conditions that may precede and indeed screate this final event (i.e., the act of doping itself). Practically, through the developed STAMP model, it would be possible to identify these interacting networks of control and feedback mechanism inadequacies and the network of actors involved. Further, the implementation of systemic investigations using systems-based accident analysis would arguably impose greater and necessary accountability on the actors throughout the entire anti-doping system

Part Four: Identification of potential control and feedback inadequacies

Introduction

The output of the control structure modelling in the previous phase provided a detailed analysis of the inherent complexity of the anti-doping system via the control and feedback mechanisms of the anti-doping system in the four football codes in Australia. The aim of this phase was to use the developed STAMP model to conduct a comprehensive prospective analysis of the different ways in which the current control and feedback mechanisms for anti-doping can fail. This analysis can be used to support the strengthening of existing controls and the development of new controls. The System-Theoretic Process Analysis (STPA, Leveson, 2011) method was used to identify the range of STAMP control and feedback failures that could occur within the current doping prevention system in football codes in Australia. STPA is a pro-active risk assessment method that was developed for use in conjunction with the STAMP control structure model. It provides the means to understand the influence of control failures across a particular system. STPA has been applied in several safety critical domains, however, it has not previously been applied in the sports Anti-doping context. STPA works by considering each of the control and feedback mechanisms described in the control structure along with an unsafe control actions taxonomy comprising the following four failure modes:

1. Control or feedback action is not provided or followed.
2. An unsafe (incorrect) control or feedback action is provided.
3. Control or feedback action is provided too early or too late (wrong time or sequence).
4. Control or feedback action is stopped too soon or applied too long (for continuous control actions, not discrete ones).

Method

One member of the research team (MN) conducted the STPA, which was reviewed by two other members (PS, SM). The STPA was refined through discussions to obtain agreement where any disagreements were identified. The process involved taking each control and feedback from the control structure model and considering the credible risks associated with the four failure modes.

For example, for the control 'WADA Code' which is enacted from the International level on the Government Agencies level, potential control failures could include:

1. Control is not provided. No unified approach to anti-doping provided resulting in a lack of guidance to countries and a weaker anti-doping system

2. Unsafe control action is provided. Inappropriate or inadequate code is provided resulting in the wrong anti-doping policy, rules & regs for anti-doping.

3. Control action is provided too late. WADA code is implemented or disseminated too late meaning that it is not enacted or followed for a period of time.

4. Control action is applied too long. The WDA code applied too long and thus does not consider emerging issues such as new forms of performance enhancing drugs, new detection prevention activities, and policy changes elsewhere in the system.

This process is followed for each control mechanism throughout the control structure model.

Once all of the controls within the control structure have been assessed, the process is conducted for each of the feedback mechanisms included in the model. For example, potential feedback failures for 'Compliance outcomes' which is passed from the Government Agencies level to the international influences level could include:

1. Feedback action not provided. No compliance outcomes are provided so stakeholders unaware of if they are compliant with current guidance.

2. Unsafe feedback action is provided. Inaccurate compliance outcomes are provided leading to a lack of clarity as to the accurate state of stakeholder's compliance with guidance.

3. Feedback action is provided too late. Compliance outcomes are provided too late, and compliance deteriorates as a result of less monitoring.

4. Feedback action is stopped too soon. Compliance outcome recordings are stopped too soon leading to inability to determine current compliance outcomes and inaccurate guidance resulting.

This process is followed for each feedback mechanism throughout the control structure model.

Results

A total of 712 risks were identified, including 428 control risks and 284 feedback risks. Extracts of the control and feedback failures are presented in Tables 2 and 3. See Appendix 3 for the entire STPA analysis.

Table 2. Example control failures taken from various levels of the STAMP control structure model.

From	To	Control	Action required but not provided	Unsafe action provided	Incorrect/ timing order	Stopped too soon/applied too long
International influence	Parliament and legislatures	Compliance Reports	No compliance reports provided resulting in inability to determine if countries are compliant with WADA code resulting in deterioration of the anti-doping system	Inappropriate compliance reports provided meaning incorrect international guidance for anti-doping	Compliance reports provided too late resulting in delayed reporting of compliance activities to inform KPIs, risks & challenges	Compliance reports are provided too early prior to identifying new risks and challenges
Parliament and legislatures	Government agencies	Funding/ resource allocation	Funding and resources not allocated anti-doping practices and detection methods aren't implemented	Funding/resource allocation not adequate to address sufficiently address ADVRs	Funding provided too late resulting in a lack of funding for testing to address ADRVs	Funding and resources allocation stopped too soon resulting in the cessation of work
Government agencies	Operational delivery & management	Allocation of testing scheduling	No testing schedule allocated meaning no testing takes place	Inappropriate testing schedule allocated provided meaning testing is insufficient	Testing schedule being provided too late resulting in athletes not being tested and testing being insufficient	Testing schedule allocation being stopped too soon resulting in athletes not being tested and testing being insufficient
Local management & supervision	Operating process & environment	Education	No education provided resulting in ineffective education provided and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used

Table 3. Example feedback failures taken from various levels of the STAMP control structure model

From	To	Control	Action required but not provided	Unsafe action provided	Incorrect/ timing order	Stopped too soon/applied too long
Operating process & environment	Local management & supervision	Education attendance data	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education attendance data provided leading to an inaccurate understanding of who has been attending education	Education attendance data provided too late to accurately capture stakeholders who attended	Education attendance data recording stopped too soon, and attendees are not recorded leading to them being viewed as uneducated
Local management & supervision	Operational delivery & management	Supplement Independent Testing	No supplement independent testing provided resulting in potentially tainted supplements being given and consumed	Inaccurate Supplement Independent Testing resulting in potentially tainted supplements being approved and consumed	Supplement Independent Testing is provided too late and potentially tainted supplements are consumed before testing and approval	Supplement Independent Testing is stopped too soon, and supplements are not tested leading to inadvertent doping
Operational delivery & management	Government agencies	Compliance Outcomes	No compliance outcomes provided so stakeholders unaware of if they are compliant with current guidance	Inappropriate compliance outcomes communicated leading to confusion about whether stakeholders are compliant with up-to-date guidance	Compliance outcomes are provided too late, and compliance deteriorates as a result of less monitoring	Compliance Outcomes recordings stopped too soon leading to inability to determine current compliance outcomes and inaccurate guidance resulting
Parliament & legislatures	International influence	Sanction data & statistics	No sanction data & statistics provided leading to an inability to track trends in testing and doping rates	Inaccurate sanction data & statistic leading to the making of guidance that does not improve current conditions and outcomes for stakeholders	Sanction data & statistics being provided too late resulting in policies which do not address the accurate state of current sanctions	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes whose sanctions should have finished.

Discussion

The STAMP-STPA analysis provides useful insights about how the anti-doping system could potentially fail. The STPA analysis also provides risk descriptions that are relevant to numerous stakeholders within the anti-doping system, identified in the STAMP control structure model.

The STPA revealed a total of 712 potential failures, including 428 control failures and 284 feedback failures. Whilst some of these potential failures may be currently well managed through strong control and feedback mechanisms, some may not be. Consequently, the list of identified potential failures provides a useful database for review when considering the effectiveness of current control and feedback mechanisms and the development of new interventions (See Appendix 3). It is recommended that sport system stakeholders review the STPA risks and their current control and feedback mechanisms to determine if further effort around the development or strengthening of control and feedback mechanisms is required.

For the controls, whilst almost a third of the potential failures relate to the operating process and environment level and the controls imposed on athletes (e.g., testing, education, enforcement), the majority relate to controls imposed on other actors in the anti-doping sport system. For example, 76 potential control failures were identified for the controls imposed by actors at the *government agencies* level on actors at the *operational delivery and management* level. These included potential failures around the quality and implementation of the national anti-doping policy, compliance monitoring, resource allocation, quality standards and assurance, and accreditation. Similarly, 40 potential control failures were identified for the controls imposed by international actors on actors at the parliament and legislatures level. For example, these included potential failures relating to the content and implementation of the WADA code, ethics guidelines, and policies and procedures. These findings demonstrate the critical need to consider risk assessment and management for all stakeholders within the anti-doping system as opposed to athlete only controls. Whilst testing currently provides a strong control for athlete doping, there may be other opportunities to strengthen the anti-doping system. For example, enhancing controls such as 'Funding and resource allocation' and 'Allocation of testing schedule' will in turn enhance testing outcomes, as more athletes can be tested in an appropriate manner, and testing protocols can keep pace with advances in performance enhancing drugs.

Part Five: Development of new doping control and feedback mechanisms

Introduction

The outputs of the STPA analysis in the previous phase provided a comprehensive predictive analysis of the different ways in which the current controls for anti-doping can potentially fail. The aim of this phase of the research is to identify new or strengthen existing control and feedback mechanisms for the anti-doping system for the four football codes.

Methods

A design workshop was conducted with eight participants (5 in person, 3 online) from Sport Integrity Australia. The purpose of the workshop was to identify potential new control and feedback mechanisms or ways in which existing controls and feedback mechanisms could be strengthened. The design process involved the use of elements of the Sociotechnical Systems Design Toolkit (STS-DT) (Read et al, 2015). The STS-DT uses system models and insights to support the design of concepts, in this case, new or modified controls and feedbacks. Participants were provided with the developed STAMP model (Part Three of the report) and five different scenarios relating to various ADRVs (see Table 4). Scenarios included topics involving athletes, coaches, and national sporting organisations, as well as emerging technologies. Scenarios were presented to participants one at a time, and they were asked to identify any control or feedback mechanisms not currently present, that could prevent the ADRV presented in the scenario from occurring. Participants worked in groups, and the online participants worked alone. The research team facilitated discussions. Each scenario was worked on for a duration of approximately 30 mins, and participants reported back to the group on any identified new or strengthened control or feedback mechanisms after each scenario. Data were recorded by one member of the research team via note taking.

Table 4. Summaries of scenarios presented to participants during the design workshop.

Scenario	Scenario summary
1	• 24-year-old Australian rules football player, only played between 6-12 matches a season • Contract will not be renewed • Is aware of the benefits of PES & has considered taking them previously • Always stopped short, as he thinks that doing so is “not right” and “not fair”. • The risk of being caught is now starting to be outweigh by his desire to play in the AFL • Does not know who he can turn to discuss these matters • Does not want to talk to anyone within the team or club • Fears being ‘dobbed in’
2	• Charlie is a 52-year-old professional football (soccer) coach • Charlie notices that a small group (3 players), have improved their physical performance outputs rapidly over the previous 12 months • They rarely fatigue and have put on a large amount of visible muscle • Fitness coach has also noticed this • Charlie recalls similar scenarios from his playing days in Europe through the 90’s • Charlie thinks they must be doping, but has no way to prove it • He also does not want the boys to get into any trouble (bans etc)
3	• Christine is a 28-year-old Australian football (soccer) player, who plays professionally for a team in Europe • Also has played for the national team for 5 years • She is regularly tested & subject to declaring her whereabouts • Struggling with a new & intense training regime with high volumes of running • Staff at the club provide her with a supplement to enhance recovery • Christine is unsure as she does not know this member of staff and their credentials, but feels pressured by the team and the staff as she wants to fit in • Other players are taking the supplement • Language barrier • Contacts national team dietician, who advises to not take it • Worried about the fallout from not taking the supplement e.g. being dropped, sponsor and media pressure to play, not selected for the national team
4	• Mona works for Rugby Australia, overseeing aspects of the integrity department where she interacts with player representatives, state and national bodies, and SIA.

	• Mona often sees and hear stories of players from other sports testing positive to PEDs but sees and hears very little of this in her role in Rugby • She wonders if it's possible to benchmark Rugby Union and Rugby sevens against other sports for key indicators of testing and education • She also wonders about the reported factors which influence and contribute to athletes testing positive for doping in team sports in Australia • She thinks is an oversight which would increase confidence in the system from the public and other stakeholders.
5	• Jamie is a 32-year-old rugby league player who plays in the front row professionally in Australia • Jamie had near career-ending leg injury in the prior season and began taking a substance which he believes is not currently being tested • He found and ordered the substance off the dark net to aid in his rehabilitation • He used cryptocurrency to purchase it, and has a mate collect it from a post office box in a different town under a fake name • His rehab was so successful he has started in each of the teams matches through the first 6 matches of the current season, and been offered a 2-year contract extension • Jamie has been regularly tested and seemingly passed those tests despite him continuing to take the substance to aid his recovery. • Jamie and his teammates are educated on the health and career risks (which they don't take seriously, and often joke about it), • He thinks at his age, any potential ban he might trigger is outweighed by the earnings potential of continuing to take The White and locking in his new contract

Results

In total, eight new controls and eight new feedback mechanisms were identified in response to the presented scenarios (Table 5).

Table 5. New controls and feedback mechanisms

Scenario	New Control (C) / Feedback (F) Mechanism	Level (from)	Level (to)
1	Anonymous player discussion forum (F)	4, 5	2, 3, 4
	Anti-doping effectiveness programme (F)	4, 5	2
	Moral controls (C)	5	5
2	Anonymous whistleblowing communication process (F)	4, 5	2
	Anonymous whistleblowing communication process (C)	2	4, 5
	Reach of education (F)	4, 5	2,
3	Player bargained anti-doping policy (F)	4, 5	2
	Player bargained anti-doping policy (C)	2	3, 4, 5
	Standardized approach between countries (C)	Int, 2	3, 4
4	Sport Specific Risk Assessments (C)	2	3
	Sport Specific Testing Benchmarks (F)	3	2
	Guaranteed Testing Funding Programmes (C)	1	2
	Annual report (C)	2	Int, 1, 2, 3, 4, 5
5	DarkNet (emerging tech) Specific Monitoring (C)	2	3, 4, 5
	Wastewater Monitoring of PEDs (C)	2	4, 5
	Wastewater Monitoring of PEDs (F)	4, 5	2

C = Control; F = Feedback; Int = International level

Discussion

Based on the scenarios provided, the participants identified new potential control and feedback mechanisms to strengthen the current anti-doping system. Multiple new controls were identified that are currently not used in the Australian football codes according to the STAMP control structure. These include a process for anonymous whistleblowing and reporting, specific risk assessments for national sports organisations, guaranteed testing funding programmes, wastewater monitoring of banned substances, and darknet monitoring for banned substances and purchases. These new controls will potentially strengthen current anti-doping efforts.

Several important feedbacks, not present in the current anti-doping system were identified. Given that education is the predominant approach for anti-doping, the STAMP control structure model suggests that there are few feedback mechanisms designed to give key stakeholders an indication of the effectiveness and reach of the education. Without such feedback, it will be difficult to optimise

anti-doping education programs or to identify when other interventions are required. This flow of information up the system hierarchy to inform decision making around interventions is known as 'vertical integration' and has been identified as a critical requirement when attempting to prevent adverse events within complex systems (Cassano-Piche et al., 2009; Rasmussen, 1997). As such, it is concluded that the inclusion of specific feedback around the reach, quality, and effectiveness of education effectiveness and reach will strengthen the current system. A further identified feedback mechanism was benchmarking of testing frequency, reach, and testing outcomes across sports. The inclusion of a feedback around benchmarking of testing frequency and prevalence statistics between different sports would provide stakeholders with improved information that would assist with policy and processes across sports. Annual reports that provide information on testing frequency, aggregated results of tests, and financial information will provide a transparent account into anti-doping practices, which will enable a learning process across codes and across sports. Anonymous athlete discussion forums, whistleblowing, player bargained anti-doping policy were also identified during the workshop. Future research is required to develop a comprehensive set of new control and feedback mechanisms beyond the scenarios presented here.

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Appendices

Appendix 1. Demographic information for the studies which were included in the final analysis, including author(s) and year of publication, country or region investigated, sport(s) investigated, participant characteristics, and the methodology and data source.

Author(s) (Year of Publication)	Country or Region Investigated	Sport(s) Investigated	Participant Characteristics	Methodology and Data Source
Aubel, Lefèvre, Le Goff, Taverna	Multiple	Road Cycling	n = 10551 athletes (271 sanctioned) (2005-2016); riding in the top 3 world divisions	Observational (Database [UCI])
Aubel, Lefèvre, Le Goff, Taverna	Multiple	Road Cycling	n = 10551 athletes (271 sanctioned) (2005-2016); riding in the top 3 world divisions	Observational (Database [UCI])
Aubel and Ohl	Multiple	Road Cycling	n = unclear (team personnel)	Observational (Semi-structured Interviews, Database Analysis)
Backhouse, Whitaker, Petróczi	Multiple (Online)	Various (32 sports)	n = 212 athletes (21.4 +/- 4.5 years); 65% M	Observational (Survey)

Bae, Yoon, Kang, Kim	South Korea	Various (24 of 28 Olympic sports during the Rio 2016 Olympic Games)	n = 198 athletes (95 F, 103 M)	Observational (Survey)
Barkoukis, Lazuras, Lucidi, Tsorbatzoudis	Greece	Various (football, basketball, volleyball, handball, athletics, swimming, shooting, taekwondo, boxing, water polo, and athletes who did not report their sport)	n = 650 (aged between 14-20 years old; Mean age = 16.09, SD = 1.50	Observational (Survey)
Barkoukis, Lazuras, Ourda, Tsorbatzoudis	Greece	Various (football, volleyball, basketball, handball, and water polo, athletes who did not report their sport)	n = 497 athletes (23.54 years old (SD = 5.75, 64% M))	Observational (Survey)

Bilard, Ninot, Hauw	France	Cycling, football	n = 155 athletes.	Observational (Transcripts of Phone-Help Service)
Bloodworth, McNamee	United Kingdom	Various	N = 40 (22 M / 18 F athletes [mean age= 19.6 years]).	Observational (Focus Groups)
Boardley, et al.	United Kingdom and the United States	Various (American football, Basketball, Boxing, Athletics, MMA, Rugby, Swimming, Wrestling)	n = 12 athletes (all M)	Observational (Semi-structured interviews)
Boardley, et al.	Australia, United Kingdom, and the United States	Various (34 sports)	n = 532 athletes (M; n = 290, F; 242)	Observational (Survey)
Chan, Hardcastle, Lentillon-Kaestner, Donovan, Dimmock, Hagger	Australia	Various (track and field, basketball, field hockey, netball, water polo, and swimming)	n = 57 athletes (Mean age = 18.02 [SD = 2.72])	Observational (Focus Groups)
Chen, Wang, Wang, Huang	China	Various (Football, volleyball,	n = 203 athletes (Mean age = 19.0 years, 36.9% F)	Observational (Survey)

		taekwondo, boxing, wrestling, badminton, fencing and free combat)		
Devcic, Bednarik, Maric, Versic, Sekulic, Kutlesa, Bianco, Rodek, Liposek	Slovenia	Swimming	n = 301 athletes (153 F, 148 M; 16.4 ± 2.4 years)	Observational (Survey)
Didymus, Backhouse	United Kingdom	Rugby league, and rugby union	n = 11 athletes (3 F and 8 M [Mean age = 22.64, SD = 2.66 years])	Observational (Semi-structured interviews)
Donovan, Egger, Kapernick, Mendoza	Various (Review)	Various (Review)	N/A (Review)	Review
Erickson, McKenna, Backhouse	United Kingdom	Various (football, rugby, field hockey, boxing and triathlon)	n = 10 athletes (aged between 18-30 years; 3 F)	Observational (Semi-structured interviews)
Fincouer (2018)	Belgium, France, Switzerland	Road Cycling	n = unclear (elite riders and staff members)	Observational (Semi-structured Interviews)
Garcia-Grimau, De la Vega, De Arce, Casado	Spain	Various (track and field)	n = 281 (both M and F, 50.5 and 49.5% of the sample, respectively)	Observational (Survey)
Harcourt, Marclay, Clothier	Australia	Australian Rules	One Australian Rules football club (Essendon)	Observational (Case Study)

Harris, Dowling, Houlihan	Russia	Various (Olympic sports)	N/A (Examined the Russian Olympic system)	Observational (Ethnographic)
Hanstad, Waddington	Various (Review)	Various (Review)	N/A (Review)	Review
Hauw, Mohamed	Unspecified	Various (tennis, track and field, cycling, volleyball, soccer, and rugby union	n = 12 coaches (All >20 years of sport practice)	Observational (Interviews)
Henning, McLean, Andreasson, Dimeo	Various (Review)	Various (Review)	N/A (Review)	Review
Hurst, Ring, Kavussanu	Unspecified	Various (team sports, individual sports)	77% M, mean age = 20.8 ± 4.5 years	Observational (Survey)
Hurst, Kavussanu, Boardley, Ring	United Kingdom	Various (Study 1; individual and team sports, Study 2; team and individual sports).	Study 1: n = 598 athletes (M [n = 417] and F [n = 191], mean age = 21.2 ± 4.5 years). Study 2: 475 athletes (M [69.5%]; mean age = 20.3 ± 2.2 years).	Observational (Survey)
Huybers and Mazanov	Australia	Various	n = 259 athletes (40% M)	Observational (Survey)

Jalleh, Donovan, Jobling	Australia	Various (Athletics, swimming, hockey, rowing, soccer, basketball, netball, cycling, softball, Australian rules football, and weightlifting/power lifting).	n = 1237 athletes (M [n = 603], F [n = 612], and not specified [n = 22], mean age 23 years [SD = 7.8 years])	Observational (Survey)
Kabiri, Masoomeh Shadmanfaat, Donner, Cochran	Iran	Various (football, taekwondo, karate, volleyball, basketball, futsal, swimming, wrestling, weightlifting, and handball)	n = 709 athletes	Observational (Survey)
Kabiri, Shadmanfaat, Donner	Iran	Various (football, taekwondo, karate, volleyball, basketball, futsal, swimming, wrestling,	n = 784 athletes	Observational (Survey)

		weightlifting, and handball).		
Kegelaers, Wylleman, De Brandt, Van Rossem, Rosier	Belgium	Various (sailing, volleyball, track and field, field hockey, judo, tennis, soccer, swimming, cycling, and basketball).	n = 36 athletes (Mean age = 28.57, SD = 8.92; 17 F), n = 5 M elite coaches (Mean age = 54.2, SD = 9.6), and n = 4 doping 'experts' (Mean age = 47.75, SD = 10.69; 1 F expert).	Observational (Interviews, focus group interviews, biographical analyses)
Kirby, Moran, Guerin	Ireland, Scandinavia, and the United States	Various (road cycling, mountain biking, and weightlifting)	n = 5 athletes (all M; aged 29-46 years)	Observational (Interviews)
Kondric, Sekulic, Petroczi, Ostojic, Rodek, Ostojic	Slovenia	Various (Racket sports; table tennis, badminton, tennis.	n = 78 athletes (table tennis), n = 83 athletes (badminton), n = 27 athletes (tennis); M and F >18 years of age	Observational (Survey)
Lentillon-Kaestner	Switzerland	Cycling	n = 16 athletes	Observational (Semi-structured interviews)

Lentillon-Kaestner, Carstairs	Switzerland	Cycling	n= 8 athletes	Observational (Semi-structured interviews)
Lentillon-Kaestner, Hagger, Hardcastle	Switzerland	Cycling	n = 16 athletes	Observational (Semi-structured interviews)
Liposek, Zenic, Saavedra, Sekulic, Rodek, Marinsek, Sajber	Slovenia	Swimming	n = 97 athletes (19.7 ± 2.3 years of age; 35 F)	Observational (Survey)
Lucidi et al.	Italy	Unspecified	n = 1232 athletes	Observational (Survey)
Matosic, Ntoumanis, Boardley, Stenling, Sedikides	United Kingdom	Various (including rugby, soccer, swimming)	n = 493 athletes (328 M, 165 F; age ranging 16-53 years, Mean age = 21.22, SD = 3.65) and 59 coaches (48 M, 11 F; age ranging 20-68 years, Mean age = 35.90, SD = 12.71)	Observational (Survey)
Mazanov, Huybers	Australia	Various (basketball, cricket, football [soccer], hockey, long distance running,	n = 29 athletes	Observational (Semi-structured interviews)

		rugby union, table tennis, tennis, triathlon, Australian Rules Football, cycling, gymnastics, softball, speed skating, touch football and weightlifting).		
Mazanov, Huybers, Connor	Australia	Various	n = 20 (four M and four F athletes, 1 F and 3 M coaches, 1 M and 3 F physiotherapists, 2 F sports nutritionists/dieticians, 1 M sports administrator, and 1 M sports scientist/researcher)	Observational (Interviews)
Morente-Sanchez, Mateo-March, Zabala	Spain	Cycling	n = 72 (mean age: 19.67 ± 4.72 years; 70.8% M [n = 51] and 29.2% F [n = 21]).	Observational (Survey)

Murray, de Rijt, Shandra	United States	Baseball, and MMA	N/A (Database investigation)	Observational (Databases)
Nicholls, Levy, Meir, Sanctuary, Jones, Baghurst, Thompson, Perry	United Kingdom, Australia, United States, and Hong Kong.	Unspecified	n = 2208 athletes (M; n = 1456, F; n = 751, unspecified; n = 1) aged between 12-18 years (Mean age = 16.36, SD = 1.69).	Observational (Survey)
Nicholls, Perry, Levy, Meir, Jones, Baghurst, Sanctuary, Thompson	United Kingdom, United States, Hong Kong, and Australia	Various (rugby union, rugby league, basketball, racquetball, track and field, rowing, and kayaking).	n = 11 coaches (10 M); aged from 34-76 years of age (Mean age = 47.45 years, SD = 12.33).	Observational (Interview)
Ntoumanis, Barkoukis, Gucciardi, Chung Chan, Chan	Greece	Various (football [soccer], rowing, handball, volleyball, and swimming.	n = 257 athletes; 159 M and 98 F aged between 15-36 years (Mean age = 21.79, SD = 3.84).	Observational (Survey)
Pappa, Kennedy	Unspecified	Track and field	n = 15 athletes (M and F), aged between 19-26 years.	Observational (Semi-structured Interviews)

Petrou, Lazuras, Hillier, Mojtahedi	United Kingdom, United States, Iceland, Australia, Canada, Ireland, Thailand, Cyprus, Czech Republic, Denmark, Fiji Islands, Greece, the Netherlands, New Zealand, Oman, and Singapore.	MMA	n = 249 athletes (Median age = 26–30 years; 59.8% M)	Observational (Survey)
Sekulic, Bjelanovic, Pehar, Pelivan, Zenic	Croatia	Rugby union	n = 105 athletes (all M; mean age = 23.6 ± 4.2 years)	Observational (Survey)
Smith	Various	Cycling	Unspecified	Observational (Statements)
Smith and Stavros	Australia	Various (Cycling, badminton, skiing, gymnastics, netball,	n = 16 athletes	Observational (Life course narrative interviews)

		powerlifting, boxing, rugby, swimming, track and field, MMA, water polo, cricket, wrestling)		
Sullivan, Razavi	United States	Rugby union; football (soccer)	N = 96 athletes (86 M, 10 F), aged between 17– 30 years (Mean age = 20.0, SD = 2.08).	Observational (Survey)
Vakhitova, Bell	United States	Cycling	US Postal Service cycling team between 1996 and 2012	Observational (Script Analysis)
Whitaker, Backhouse	United Kingdom	Rugby union	n = 50; 49 athletes, 1 coach	Observational (UKAD Database)
Whitaker, Long, Petróczi, Backhouse	United Kingdom	Various (cycling, athletics, badminton, football, and hockey.	n = 729 athletes (mean age = 28.8 ± 10.1 years; 63% M)	Observational (Survey)
Zucchetti, Candela, Villosio	Italy	Various (Resistance sports, other sports).	n = 109 athletes (85% M, n = 93; 15% F, n = 16; mean age = 31.5, SD = 13.78).	Observational (Survey)

M = male, F = Female, MMA – Mixed martial arts, UCI- Union Cycliste Internationale, UKAD – United Kingdom Anti-Doping

Appendix 2. The identified contributory factors mapped to Rasumussen's Risk Management Framework (RMF) AcciMap with further descriptive details as to how the factor contributes to doping and doping behaviours, attitudes, and beliefs.

RMF Level	Contributory Factor	Details
International influences	Policy makers	• The likelihood of doping is high when the threat of being tested and the penalties for failing a test are low. • Perceived legitimacy of anti-doping laws and enforcement is low influencing doping. • Weak structural conditions of anti-doping governance permitted state-sponsored doping. • Predicting (or knowing) when anti-doping testing will occur to manage positive test risk. • Push factors towards doping include a low chance of being caught and the risk of light sanctions if caught.

Governments and governing bodies	Government	• The deep structures within the government promoted doping to the point it reached state sponsored proportions. The power dynamics within and between government actors and governance of sport more broadly promoted a thriving doping culture.
Regulatory bodies and associations	Policy makers	• The lack of (or infrequent nature of) testing within their sport influencing detection likelihood. • The lack of sport-specific anti-doping education. • Athletes felt that the organizing bodies of their sports were complicit in the evolution of doping because of a reluctance to face up to the problem for so long. • The change in the sport anti-doping policy over time influencing fear of anti-doping tests (especially out of competition). • Hypocrisy of the treatment of doping cases by the sport. • A perception that doping had become normalised in their sport (without sanction) and they needed to dope to "level the playing field".
	Media	• Media pressure to be successful as the media (including social media) is overly focused on results and too quick to critique what they consider subpar performance.
Teams and organisations	Team	• Doping practices can reveal a team's weak economic or sporting position. • Riding for certain teams increases the likelihood of a positive test. • Culture of the sporting team may account for the mediating role of moral disengagement and positive doping attitudes. • Weak team structure and governance leads to a high doping risk. • Normalisation of use within the team, pressure to conform, and code of silence ('*Omerta*'). • Former cyclists describe a doping programme that was endorsed and organised by the professional teams. • Recently turned professionals observed the subtle pressure from team managers to dope. • Cyclists legitimated doping as a normal part of the team and its functioning.

		• Players who transfer to a team with at least one prior confirmed doping user are more likely to begin doping than players who transfer to teams without a prior confirmed doping user. • Team management facilitate the administration and management of doping by connecting athletes to experts, organising payments, and protecting the athlete from negative consequences. • Specific team culture and poor supervision at the core of the everyday experience.
	Sponsors	• Sponsors as a subtheme of role models in sport that influence a player's engagement with prohibited substances. • The expected financial gain associated with doping including winning medals, contracts, sponsorship, and other accolades. • Winning sponsorship/contracts and not losing sponsorship/contracts once gained were motivations to dope. • Athletes are more likely to dope if they consider that their funding was under threat due to a perceived dip in performance.
Direct supervisors, management, medical and performance personnel	Medical/Sports Science Staff	• Sports science and sports medicine trained staff have an influence on the systematic institutionalisation of doping in sport, with a view that they are "one step ahead" of the antidoping testing regime. • Strength and conditioning coaches' ability to predict athlete doping susceptibility is mediated by confrontation efficacy and moral disengagement. • The medical staff prescribed an unknown substance to take in pre-competition for the entire team which was described as a "vitamin". The staff then undertook regular blood testing to adjust the dosages. • The medical staff and medical environment (e.g., labs, hygienic equipment etc.) represent enablers to systematic doping in the micro-environment. • Athletes consulted with medical practitioners to design their doping programme.

		• Cycling teams often let the trainers undertake the doping programme away from the direct view of the team's management. • Perceived social approval for doping from referent groups (including medical/sports science staff) influences doping intentions. • Medical staff provide access to information about doping and instructions on using banned substances and/or banned practices.
	Coach	• The coaching criticism or perfectionism culture influences athlete concern over mistakes which is related to doping attitudes. • The norms associated with the sport including the coach-athlete relationship, and coaches' choices influence doping. • Coaches' ability to predict athlete doping susceptibility is mediated by confrontation efficacy and moral disengagement. • It is widely accepted that coaches exert a powerful influence on the athletes' doping susceptibility as they are held in particularly high reverence and esteem. • A controlling coaching style is positively associated with doping attitudes and this relationship is mediated by moral disengagement. • The coach has a key influence in shaping athletes attitudes and decision making processes to doping throughout their career. • The greater endorsement of doping by coaches, the more likely were positive attitudes towards doping by athletes. • Coach opinion (e.g., their moral stance) have a direct relationship to athlete doping attitudes, which in turn is positively associated with doping behaviour. • Coaches can have a role as a 'direct influencer' as a push factor in actively encouraging athletes to dope, to provide guidance, and (at times) to help administer doping. • A perceived lack of trust in their coach when it comes to doping issues. • Coach strategy (indifference and nonchalance) and training content (lacking diversity and large volumes of training) were positively related to doping attitudes.

		• Coach narcissism was directly and positively related to athlete perceptions of controlling behaviour which was positively associated with doping attitudes. • Coach controlling behaviour was positively related to doping via athlete frustration, moral disengagement, and endorsement of cheating.
	Doctor	• The doctor is a main source of information and influence on decisions to dope. • Doctors are often responsible for introducing doping practices to new team members and legitimate the practice as part of the regular work performance. • Doctors provide access to information about doping and instructions on using banned substances and carrying out banned practices, as well as supply.
Athlete, teammates, and opponents	Teammates	• Athletes see or hear of their teammates doping and be encouraged to do so to achieve a similar level of performance. • Social contextual factors, such as contact with teammates who dope, relate to pro doping attitudes and behaviours. • Athletes who self-report doping perceive their behaviour to be socially accepted by their teammates as means to normalise or rationalise their choices. • Teammates in the training environment are particularly influential in decisions to dope as they affect the perceptions that doping practices are pervasive which allows athletes to diffuse personal responsibility for their actions.
	Opponents	• Conforming to social norms that exist within their sport, including between athletes and their opponents. • Comparison of performance level with their opponents, citing they can now not compete against opponents who they previously could, due to doping. • Opponents and competitors are a key source of influence on decisions of doping.

		• Belief that competitors doping behaviours were deviant but a important influence on whether they should dope.
	Parents	• Parents are a key source of influence and approval on doping related attitudes. • "Ineffective parenting" has a positive and direct effect on athletes doping use as well as athlete self-control. • Attitudes towards doping of parents influences doping susceptibility of their athletes.
	Friends	• Influence of friends within the general culture (outside of their sport) exerts pressure to do as others are doing. • Having peers involved in doping can directly effects on athletes doping. • Doping susceptibility is positively predicted by positive attitudes towards doping in the athletes friendship reference group. • Having a social network of friends with positive attitudes towards doping influences the athletes doping related attitudes.
	Family	• Family members push younger athletes to take performance enhancing drugs to achieve, • Performance enhancing drug use likelihood is influenced by the supportive opinions of the family reference group to doping and performance enhancing drug use. • The social consequences associated with doping (e.g., reaction of family) influence doping behaviours. • The lack of a stable family life is considered an important factor which relates to doping. • Family members often act as general support to doping and may serve as doping couriers or to deceive the anti-doping authorities.
Equipment, substances, methods, and testing environment	Dietary Supplements	• Doping is far more prevalent or likely in regular dietary supplement users compared to nonusers. • Dietary supplement users report stronger doping intentions and positive attitudes towards doping compared to those do not use dietary supplements.

		• A self-admitted doper's behaviour of taking many dietary supplements prescribed by the team nutritionist, without knowing the contents of the supplements, which required regular blood monitoring to adjust the dosage. • The (over)use of dietary supplements can decrease the threshold to start using performance enhancing substances (i.e., 'doping') in the same manner as legal supplements.

Appendix 3. STPA analysis for the Controls identified in the STAMP control structure model (Part Three)

From	To	Control	Action required but not provided	Unsafe action provided	Incorrect/timing order	Stopped too soon/applied too long
International influence	Parliament and legislatures	Compliance Reports	No compliance reports provided resulting in inability to determine if countries are compliant with WADA code resulting in deterioration of the anti-doping system	Inappropriate compliance reports provided meaning incorrect international guidance for anti-doping	Compliance reports provided too late resulting in delayed reporting of compliance activities to inform KPIs, risks & challenges	Compliance reports are provided too early prior to identifying new risks and challenges
International influence	Parliament and legislatures	Coordination & agreements	No regulations for anti-doping being able to be developed based on agreement with WADA	Inappropriate agreements provided on anti-doping a meaning a lack of international guidance	unified or coordinated approach to anti-doping is communicated too late meaning there is no unified approach	Coordination and agreements are applied too long resulting in outdated approaches

International influence	Parliament and legislatures	International standards and guidelines	No standard provided meaning a lack of congruency with international best practice resulting in a weaker anti-doping system	Inappropriate Int standards & guideline meaning incorrect guidance provided	standards & guidelines communicated too late meaning they are not initially followed	Standards and guidelines applied too long resulting in outdated guidance
International influence	Parliament and legislatures	Reasoned Decisions (CAS)	Reasoned decisions are not provided leaving the rationale for anti-doping sanctions unclear and weakening deterrence	Inappropriate reasoned decision made meaning incorrect decisions	Reasoned decisions provided too soon before appropriate evidence is collected	Reasoned decisions are applied too long resulting in outdated approaches
International influence	Parliament and legislatures	Targets and performance measures	No clear guidance on if performance against the code is being met resulting in poor performance	Inappropriate targets & performance measures provided resulting in incorrect of guidance on acceptable international standards	Targets & performance measures are provided too late meaning they are not followed initially	Targets and performance measures are stopped too soon and performance declines
International influence	Parliament and legislatures	WADA Code	No unified approach to anti-doping provided resulting in a lack of guidance to countries and a weaker anti-doping system	Inappropriate code provided resulting in the wrong anti-doping policy, rules & regs for anti-doping	Wada code provided too late meaning that it is not followed prior to communicating it	WADA code applied too long without updates resulting in outdated content
International influence	Parliament and legislatures	WADA Ethics	No ethical framework with which to guide decision making resulting in poorer decisions	Inappropriate ethics provided resulting in incorrect of international guidance for ethical standards	Wada ethics are provided too late meaning that they are not followed prior to communicating them	WADA ethics applied too long resulting in outdated ethical procedures
International influence	Parliament and legislatures	WADA International standards	No unified approach to anti-doping provided resulting in a lack of guidance to countries and a weaker anti-doping system	Inappropriate standards provided meaning incorrect international guidance for anti-doping	Standards are provided too early	Standards applied too long resulting in outdated guidance
International influence	Parliament and legislatures	WADA Legal	No legal framework with which to guide decision making resulting in poorer decisions	Laws, rules and regs inappropriate for ADRVs in Australia	Laws, rules, and regs are provided too late resulting in organisations not following up to date legal guidance	Laws are applied too long resulting in the application of unlawful guidance
International influence	Parliament and legislatures	WADA Policy and Procedures	No unified approach to anti-doping provided resulting in a lack of guidance to countries and a weaker anti-doping system	Incorrect policy & procedures provided resulting in the wrong guidance for ADVRs	Policy and procedures provided too late resulting in them being out-of-date when they are applied	Policies and procedures are stopped too soon resulting in the following of inappropriate policies and procedures
Parliament and legislatures	Government agencies	Coordination & agreements	No coordination's or agreements provided meaning no unified approach to anti-doping	Inappropriate agreements provided on anti-doping a	Agreements provided too late resulting in older agreements being relied on which may be out-of-date	Agreements applied for too long resulting in outdated guidance

				meaning a lack of parliamentary guidance		
Parliament and legislatures	Government agencies	Funding/resource allocation	Funding and resources not allocated anti-doping practices and detection methods aren't implemented	Funding/resource allocation not adequate to address sufficiently address ADVRs	Funding provided too late resulting in a lack of funding for testing to address ADRVs	Funding and resources allocation stopped too soon resulting in the cessation of work
Parliament and legislatures	Government agencies	Laws, rules & regulations	Legal frameworks not in place for government anti-doping agencies resulting in illegal practices	Laws, rules and regs inappropriate for ADVRs	Laws, rules, and regs are provided too late resulting in organisations not following up to date legal guidance	Laws, rules, and regs are applied for too long resulting in the application of unlawful guidance
Parliament and legislatures	Government agencies	Political objectives	No political objectives provided resulting in a lack of policy on anti-doping	Inappropriate political objectives provided resulting in the wrong policy development for anti-doping	Political objectives being provided too late resulting in inappropriate policy development that meets the current political objectives	Political objectives are stopped too soon resulting in misguided approaches that don't meet the current objectives
Parliament and legislatures	Government agencies	Strategic research priorities	No strategic research priorities provided resulting in lack of guidance for research that is required	Incorrect research priorities provided regarding anti-doping	Research priorities being priorities too late provided resulting in lack incorrect policy provided that meets incorrect current political objectives	Research priorities are applied too long and are no longer current resulting in outdated approaches
Parliament and legislatures	Government agencies	Strategy, policy, actions plan's	No strategy, policy, procedures & action plans provided meaning no guidance for governmental agencies	Inappropriate strategy, policy & action plans provided resulting in incorrect guidance for anti-doping agencies	Delayed strategy, policy, & action plans resulting in out-of-date guidance being followed by anti-doping agencies	Strategy, policy, and action plans are stopped too soon and there is a lack of guidance in decision making
Parliament and legislatures	Government agencies	Targets and performance measures	No targets and performance measure provided meaning that targets and performance are unknown	Inappropriate targets & performance measures provided resulting in incorrect of guidance on acceptable standards	Targets & performance measures are provided too late meaning they are not followed initially	Targets and performance measures are stopped too soon and performance declines
Government agencies	Operational delivery & management	Accreditation	No accreditation provided resulting in no standardised qualifications to perform activities	Inappropriate accreditation provided meaning incorrect qualifications to perform activities	Accreditation being provided too late resulting in out-of-date qualifications being relied upon to perform activities	Accreditation stopped too short resulting in operational delivery ceasing before it should have
Government agencies	Operational delivery & management	Allocation of testing scheduling	No testing schedule allocated meaning no testing takes place	Inappropriate testing schedule allocated provided meaning testing is insufficient	Testing schedule being provided too late resulting in athletes not being tested and testing being insufficient	Testing schedule allocation being stopped too soon resulting in athletes not being tested and testing being insufficient

Government agencies	Operational delivery & management	Audits & inspections	No audits and inspections carried out resulting in doping practices	Inappropriate audits and inspections provided resulting in doping practices	Audits & inspections not being undertaken on time resulting in inefficient anti-doping practices and testing	Audits & inspections stopped too soon resulting in inappropriate practices not being detected and inefficient anti-doping
Government agencies	Operational delivery & management	Australian National Anti-doping Policy	No anti-doping policy provided resulting in no policy for anti-doping	Inappropriate policy provided resulting in incorrect policy for anti-doping	Anti-doping policy provided too late resulting in it being out-of-date when applied	Antidoping policy being applied for too long resulting in outdated guidance
Government agencies	Operational delivery & management	Case law	No case law provided meaning no basis on precedents communicated	Inappropriate case law provided meaning incorrect basis on precedents communicated	Case law provided too late resulting in incorrect precedents being relied upon for decisions	Case law are applied too long resulting in the application of outdated and potentially unlawful guidance
Government agencies	Operational delivery & management	Collective agreements	No collective agreements provided resulting in no outlines of conditions between stakeholders	Inappropriate collective agreements provided resulting in the wrong outlining of conditions	Collective agreements being provided too late resulting in reliance in out-of-date agreements for decision making	Collective agreements stopped too early resulting in practice which isn't covered under an agreement
Government agencies	Operational delivery & management	Compliance Monitoring	No compliance monitoring undertaken resulting in a lack of ability to determine compliance	Insufficient compliance monitoring provided resulting in	Compliance monitoring provided too late resulting in delayed monitoring of compliance activities to inform KPIs, risks & challenges	Compliance monitoring is provided too early prior to identifying new risks and challenges
Government agencies	Operational delivery & management	Contractual agreements	No contracts written up resulting in no enforceable agreements	Incorrect contracts written up resulting in the wrong enforceable agreements	Contractual agreements being written up too late resulting in reliance on out-of-date agreements for decisions	Contractual agreements being provided too late resulting in reliance on outdated agreements and guidance
Government agencies	Operational delivery & management	Data and statistics	No data provided resulting in an inability to measure performance	Incorrect data provided resulting in misleading data	Data and statistics being provided too late resulting in decisions being made on incorrect and misleading information	Data and statistics stopped too early resulting in up-to-date information not being collected and used in decision making
Government agencies	Operational delivery & management	Education	No education provided resulting in athletes uneducated in anti-doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
Government agencies	Operational delivery & management	Funding/resource allocation	Funding and resources not allocated to anti-doping practices and detection methods aren't implemented	Funding/resource allocation not adequate to sufficiently address ADVRs	Funding provided too late resulting in a lack of funding for testing to address ADRVs	Funding and resources allocation stopped too soon resulting in the cessation of work

Government agencies	Operational delivery & management	Guidelines	No guidelines provided resulting in anti-doping procedures that are not appropriate or substandard	Inappropriate guideline provided resulting in wrong course of action	Guidelines provided too late resulting in a reliance on out-of-date information for guidance	Guidelines applied too early resulting in outdated guidelines being used
Government agencies	Operational delivery & management	Legal penalties (fines, disqualification, etc)	No legal penalties resulting in illegal or substandard practices	Inappropriate legal penalties provided resulting in illegal practices	Legal penalties provided too late resulting in athletes who have an ADRV performing for longer than they otherwise would have	Fines, disqualifications, and sanctions are stopped too early, and athletes return to sport before they otherwise would have
Government agencies	Operational delivery & management	Memorandums of understanding	No memorandums of understanding agreed to resulting in a lack of consistency in application	Inappropriate MoU provided resulting in incorrect outlines of agreements	MoU provided too late resulting in reliance on out-of-date outlines of agreements	MoU applied too long resulting in them being outdated and irrelevant
Government agencies	Operational delivery & management	Quality Standards and Assurance	No quality standards and assurance provided resulting in lack of guidance for and that is required	Inappropriate standards & assurances provided meaning incorrect guidance	Standards are provided too late meaning reliance on out-of-date guidance negatively influencing decision making	Quality standards and assurance is stopped too early and quality of decision making deteriorates
Government agencies	Operational delivery & management	Research funding allocation	No research funding allocated resulting in no research into anti-doping or doping	Funding allocated to outside of priority areas resulting in lack of information on doping	Funding provided too late resulting in a lack of research funding to investigate doping and anti-doping activities to address ADRVs	Research funding allocation is stopped too soon resulting in the cessation of research work
Government agencies	Operational delivery & management	Research priorities	Research priorities not provided resulting in a lack of guidance for required research	Incorrect research priorities provided resulting in irrelevant research	Research priorities being prioritised too late resulting in lack of policy that meets incorrect current objectives	Research priorities are applied too long and are no longer current resulting in outdated approaches
Government agencies	Operational delivery & management	Research recommendations	No recommendations available to guide operational delivery resulting in substandard anti-doping practices	Incorrect research recommendations provided meaning wrong guidance for research projects on anti-doping	Research recommendations being given too late resulting in policy to that meets incorrect current objectives	Research recommendations are applied too long resulting in the use of outdated research recommendations
Government agencies	Operational delivery & management	Targets and performance measures	No targets and performance measure provided meaning that targets and performance are unknown	Inappropriate targets & performance measures provided resulting in incorrect of guidance on acceptable standards	Targets & performance measures are provided too late meaning they are not followed initially	Targets and performance measures are stopped too soon and performance declines
Operational delivery & management	Local management & supervision	Accreditation/licensing	No accreditation or licensing provided meaning practitioners are undertaking tasks without accreditation in the tasks they are doing	Inappropriate accreditation/licensing provided meaning incorrect standardised qualifications	Accreditation being provided too late resulting in out-of-date qualifications being relied upon to perform activities	Accreditation stopped too short resulting in operational delivery ceasing before it should have

Operational delivery & management	Local management & supervision	Audit	No audits and inspections carried out resulting in practices against the code	Inappropriate audits provided resulting in unknown practices	Audits not being undertaken on time resulting in inefficient anti-doping practices and testing	Audits stopped too soon resulting in inappropriate practices not being detected and inefficient anti-doping
Operational delivery & management	Local management & supervision	Education	No education provided resulting in ineffective education provided and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
Operational delivery & management	Local management & supervision	Enforcement planning and strategies	No enforcement of fines, suspensions, or sanctions resulting in athletes who are doping continuing to dope and perform	Inappropriate enforcement planning & strategies provided meaning incorrect direction on how to enforce penalties	Enforcement planning & strategies and who too late meaning they and not followed initially	Enforcement planning and strategies stopped too soon resulting in a lack of enforcement for penalties and athletes doping as a result
Operational delivery & management	Local management & supervision	Fines, suspensions, and sanctions	No fines, suspensions, or sanctions handed down resulting in athletes who are doping continuing to dope and perform	Inappropriate fines, suspensions, or sanctions resulting in continuation of doping	Fines, suspensions, and sanctions being provided late resulting in the continuation of doping	Fines, suspensions, and sanctions are stopped too early, and athletes return to sport before they otherwise would have
Operational delivery & management	Local management & supervision	Funding/resource allocation	Funding and resources not allocated anti-doping practices and detection methods aren't implemented	Funding/resource allocation not adequate to address sufficiently address ADVRs	Funding provided too late resulting in a lack of funding for testing to address ADRVs	Funding and resources allocation stopped too soon resulting in the cessation of work
Operational delivery & management	Local management & supervision	Infrastructure management planning	No planning around management of infrastructure and facilities resulting in an inability to facilitate testing and minimised testing	Inappropriate planning provided meaning incorrect guidance for infrastructure management	Infrastructure planning being provided too late resulting in lack of appropriate infrastructure available and mismanagement	Infrastructure management planning is stopped too soon resulting in poorer infrastructure and declining performance
Operational delivery & management	Local management & supervision	Initiatives	No special anti-doping initiatives undertaken resulting in less anti-doping initiatives	inappropriate initiatives provided meaning limited opportunity to offer to solve problems or be rewarded	Initiatives being provided too late meaning there is limited opportunities to problem solve	Initiatives are stopped too soon resulting in worsening practice and decision making
Operational delivery & management	Local management & supervision	Policy & procedures	No policy and procedures provided meaning no guidance provided for the local management and supervision	Incorrect policy & procedures provided resulting in the wrong guidance for anti-doping	Policy and procedures provided too late resulting in them being out-of-date when they are applied	Policies and procedures are stopped too soon resulting in the following of inappropriate policies and procedures
Operational delivery & management	Local management & supervision	Registration	No registrations provided meaning no official record of information	Inappropriate registrations provided meaning incorrect official recording of information	Registration is provided too late meaning that information is out-of-date when recorded and used for decision making	Registration is stopped too soon, and stakeholders may be working unregistered

Operational delivery & management	Local management & supervision	Rules and regulations	No rules and regulations provided resulting in ineffective rules and regulations application and an increase in athlete doping	Inappropriate rules & regs provided resulting in wrong guidance/instructions	Rules and regs are provided too late resulting in inadequate guidance and instruction is used.	Rules and regs are applied for too long resulting in the application of inappropriate or unlawful guidance
Operational delivery & management	Local management & supervision	Standards & codes of practice	No standards & codes of practice provided resulting in inability to detect doping practices	Incorrect standards & codes of practice provided resulting in doping practices	Standards & codes of practice are communicated too late meaning they are not initially followed	Standards & codes of practice are applied for too long and become outdated resulting in declining performance
Operational delivery & management	Local management & supervision	Supplement Independent Testing	Lack of independent testing of supplements result in potentially tainted supplements being consumed knowingly or unknowingly	Inappropriate independent supp testing resulting tainted supplements being consumed knowingly or unknowingly	Supplement independent testing is delayed resulting in tainted supplements being consumed knowingly or unknowingly	Supplement independent testing is stopped too soon resulting in tainted supplements not being detected
Operational delivery & management	Local management & supervision	Targets and performance measures	No targets and performance measure provided meaning that targets and performance are unknown	Inappropriate targets & performance measures provided resulting in incorrect of guidance on acceptable standards	Targets & performance measures are provided too late meaning they are not followed initially	Targets and performance measures are stopped too soon, and performance is no longer measured and thereafter declines
Operational delivery & management	Local management & supervision	Training policies & procedures	No training policies and procedures provided resulting in no guidelines for training	Inappropriate training policies and procedures in testing resulting incorrect guidelines for training	Training policies & procedures are provided too late resulting in out-of-date training being used by stakeholders	Training policies and procedures are stopped too soon resulting in the following of inappropriate training policies and procedures
Local management & supervision	Operating process & environment	Audit	No audits and inspections carried out resulting in practices against the code	Inappropriate audits provided resulting in unknown practices	Audits not being undertaken on time resulting in inefficient anti-doping practices and testing	Audits stopped too soon resulting in inappropriate practices not being detected and inefficient anti-doping
Local management & supervision	Operating process & environment	Doping control	Doping control is not undertaken resulting in athletes continuing to dope	Inappropriate doping controls provided resulting in athletes continuing to dope	Doping control being undertaken too late resulting in players missing their tests and continuing to dope	Doping control is applied too long resulting in outdated practice
Local management & supervision	Operating process & environment	Education	No education provided resulting in ineffective education provided and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
Local management & supervision	Operating process & environment	Medical testing	No medical testing provided resulting on knowledge of athlete medical status	Inappropriate medical testing provided resulting in incorrect knowledge of athlete medical status	Medical testing being undertaken too late resulting in missing a medical condition that would otherwise have been captured	Medical testing is stopped too early and medical issues are missed resulting in worsening outcomes

Local management & supervision	Operating process & environment	Social feedback	No social feedback to players resulting in them not understanding the social norms of the environment and potentially doping	Inappropriate social feedback resulting in incorrect understanding of social norms towards doping	Social feedback regarding doping being provided too late and the athlete continuing to dope	Social feedback is stopped too early and decision-making declines after it's cessation
Local management & supervision	Operating process & environment	Standard operation procedures	No standard operating procedures resulting in no procedural consistency	Inappropriate SOPs resulting in incorrect procedural consistency	Standard operating procedures being provided too late and older and inappropriate procedures are followed as a result	Standard operation procedures are stopped too early, and outcomes worsen for stakeholders as they follow outdated procedures
Local management & supervision	Operating process & environment	Supervision	No supervision provided resulting in a lack of support, instruction and feedback to players	Inappropriate supervision provided resulting in a lack of support, instruction for athletes	Supervision being provided too late and the athlete continuing to dope	Supervision is stopped too early and decision-making declines in its absence
Local management & supervision	Operating process & environment	Surveillance	Surveillance of potential dopers is not undertaken so athlete continue to dope	Inappropriate surveillance provided so athletes continue to dope	Surveillance being provided too late and athletes continuing to access elicit substances to dope	Surveillance is stopped too early and decision-making declines in it's absence
Local management & supervision	Operating process & environment	Targets and performance measures	No targets and performance measure provided meaning that targets and performance are unknown	Inappropriate targets & performance measures provided resulting in incorrect of guidance on acceptable standards	Targets & performance measures are provided too late meaning they are not followed initially	Targets and performance measures are stopped too soon, and performance is no longer measured and thereafter declines
International influence	Government agencies	Anti-Doping Administration Management Systems (ADAMS)	The ADAMS system not being in place resulting in a lack of consistency of record keeping and a weaker anti-doping system	ADAMs put in place incorrectly resulting in incorrect record keeping	ADAMs being undertaken too late resulting in incorrect and out-of-date information being collected and used for decision making	ADAMs being stopped too soon resulting in up-to-date information not being collected and reliance on out-of-date information for decision making
International influence	Government agencies	Compliance Monitoring	No compliance monitoring undertaken resulting in the lack of ability to determine compliance	Inappropriate compliance monitoring provided	Compliance monitoring provided too late resulting in delayed monitoring of compliance activities to inform KPIs, risks & challenges	Compliance monitoring is provided too early prior to identifying new risks and challenges
International influence	Government agencies	Education requirements	No information as to the education requirements necessary, resulting in no education provided	Inappropriate education requirements provided resulting in the wrong education provided	Education requirements being provided too late resulting in stakeholders not having education provided which is appropriate	Education requirements being stopped too early resulting in an inability to identify who is receiving education
International influence	Government agencies	Research funding	No research funding allocated resulting in no research into anti-doping or doping	Research funding not adequate to appropriately address anti-doping research	Funding provided too late resulting in a lack of research funding to	Research funding is stopped too soon resulting in the cessation of research work

					investigate doping and anti-doping activities to address ADRVs	
International influence	Government agencies	Research recommendations	No recommendations available to guide operational delivery resulting in substandard anti-doping practices	Incorrect research recommendations provided meaning wrong guidance for research projects on anti-doping	Research recommendations being given too late resulting in policy to that meets incorrect current objectives	Research recommendations are applied too long resulting in the use of outdated research recommendations
International influence	Government agencies	Substance information	No information provided as to new and existing substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Incorrect information provided on substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Substance information being provided too late resulting in out-of-date information being relied on for decision making by stakeholders	Substance information is stopped too soon resulting in incorrect information being provided to stakeholders for decision making
International influence	Government agencies	Testing and collection (NADOs)	Testing and collection of samples is not undertaken in foreign countries by the relevant NADO, resulting in athletes not being tested and continuing to dope	Testing and collection performed incorrectly resulting in invalid tests	Testing and collection being provided too late resulting in athletes not being tested and testing being insufficient	Testing and collection being stopped too soon resulting in athletes not being tested and testing being insufficient
International influence	Government agencies	WADA International standards	No unified approach to anti-doping provided resulting in a lack of guidance to countries and a weaker anti-doping system	Inappropriate standards provided resulting in incorrect international guidance	Standards are provided too late meaning reliance on out-of-date guidance negatively influencing decision making	WADA International standards applied too long resulting in outdated guidance
International influence	Operational delivery & management	Anti-Doping Administration Management Systems (ADAMS)	The ADAMS system not being in place resulting in a lack of consistency of record keeping and a weaker anti-doping system	ADAMs put in place incorrectly resulting in incorrect record keeping	ADAMs being undertaken too late resulting in incorrect and out-of-date information being collected and used for decision making	ADAMs being stopped too soon resulting in up-to-date information not being collected and reliance on out-of-date information for decision making
International influence	Operational delivery & management	Fines, suspensions, and sanctions	No fines, suspensions, or sanctions handed down resulting in athletes who are doping continuing to dope and perform	Inappropriate fines, suspensions, or sanctions resulting in continuation of doping	Fines, suspensions, and sanctions being provided late resulting in the continuation of doping	Fines, suspensions, and sanctions are stopped too early and athletes return to sport before they otherwise would have
International influence	Operational delivery & management	International governing associations education	No education provided resulting in increased in athlete doping	Incorrect education provided resulting in increased athlete doping	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	International governing associations education stopped too early resulting in outdated approaches being used

International influence	Operational delivery & management	International governing associations regulations	No regulation provided resulting in no rules or directives for anti-doping	Inappropriate regulation provided resulting in incorrect rules or directives for anti-doping	Rules and regs are provided too late resulting in inadequate guidance and instruction is used.	International governing bodies regulations are applied for too long resulting in the application of inappropriate or unlawful guidance
International influence	Operational delivery & management	Substance information	No information provided as to new and existing substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Incorrect information provided on substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Substance information being provided too late resulting in out-of-date information being relied on for decision making by stakeholders	Substance information is stopped too soon resulting in incorrect information being provided to stakeholders for decision making
International influence	Operational delivery & management	WADA Lab Accreditation	No accreditation for the lab from WADA resulting in lack of consistency in sample collection and potential to miss catching dopers	Inappropriate accreditation provided meaning incorrect qualifications to perform sample collection and testing	Lab accreditation being provided too late resulting in a labs accreditation lapsing and them becoming reaccredited	WADA Lab Accreditation stopped too short resulting in operational delivery ceasing before it should have
International influence	Local management & supervision	Education	No education provided resulting in ineffective education provided and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
International influence	Local management & supervision	Fines, suspensions, and sanctions	No fines, suspensions, or sanctions handed down resulting in athletes who are doping continuing to dope and perform	Inappropriate fines, suspensions, or sanctions resulting in continuation of doping	Fines, suspensions, and sanctions being provided late resulting in the continuation of doping	Fines, suspensions, and sanctions are stopped too early and athletes return to sport before they otherwise would have
International influence	Local management & supervision	Substance information	No information provided as to new and existing substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Incorrect information provided on substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Substance information being provided too late resulting in out-of-date information being relied on for decision making by stakeholders	Substance information is stopped too soon resulting in incorrect information being provided to stakeholders for decision making
International influence	Operating process & environment	Education	No education provided resulting in ineffective education provided and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
International influence	Operating process & environment	International governing association's requirements	No requirements provided resulting in a no understanding of compulsory approaches to anti-doping	Inappropriate requirements provided resulting in an incorrect understanding of compulsory approaches to anti-doping	Requirements are provided too late resulting in an incorrect understanding of the most current approached to anti-doping	International governing associations requirements stopped too soon resulting in an incorrect

						understanding of what is required to be compliant with anti-doping
International influence	Operating process & environment	International governing association's whereabouts requirements	No whereabouts requirements provided resulting in no understanding of how to conduct whereabouts procedures	Inappropriate whereabouts requirements provided resulting in an incorrect understanding of how to conduct whereabouts procedures	Whereabouts requirements being provided too late resulting in an incorrect understanding of the athlete's whereabouts commitments and inefficient anti-doping practices	International governing associations whereabouts requirements stopped too soon resulting in an inability to find athletes and test them, with inefficient anti-doping practices resulting.
Government agencies	Local management & supervision	Accreditation	No accreditation provided resulting in no standardised qualifications	Inappropriate accreditation provided meaning incorrect standardised qualifications	Accreditation being provided too late resulting in accreditation lapsing and stakeholders becoming reaccredited	Accreditation stopped too short resulting in operational delivery ceasing before it should have
Government agencies	Local management & supervision	Education	No education provided resulting in ineffective education and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
Government agencies	Local management & supervision	Education audit	No education audit undertaken resulting in no knowledge of education being provided	Inappropriate education audit undertaken resulting in incorrect knowledge of education being provided	Education audits not being undertaken on time resulting in out-of-date and inefficient anti-doping education practices being used	Education audits being stopped too early resulting in an inability to identify who is receiving education
Government agencies	Local management & supervision	Fines, suspensions, and sanctions	No fines, suspensions, or sanctions handed down resulting in athletes who are doping continuing to dope and perform	Inappropriate fines, suspensions, or sanctions resulting in continuation of doping	Fines, suspensions, and sanctions being provided late resulting in the continuation of doping	Fines, suspensions, and sanctions are stopped too early, and athletes return to sport before they otherwise would have
Government agencies	Local management & supervision	Sanction History	No sanction history provided meaning no knowledge of prior sanctions	Incorrect sanction history provided resulting in the wrong knowledge of prior sanctions	Sanction history being provided too late resulting in the incorrect knowledge about the athletes' current sanctions and them continuing to compete whilst under sanction	Sanction History information stopped too soon resulting in reliance on outdated information for decision making.
Government agencies	Local management & supervision	Substance information	No information provided as to new and existing substances which are banned resulting in players consuming substances to	Incorrect information provided on substances which are banned resulting in players consuming	Substance information being provided too late resulting in out-of-date information being relied on for decision making by stakeholders	Substance information is stopped too soon resulting in incorrect information being provided to stakeholders for decision making

			dope (intentionally or unintentionally)	substances to dope (intentionally or unintentionally)		
Government agencies	Operating process & environment	Accreditation	No accreditation provided resulting in no standardised qualifications	Inappropriate accreditation provided meaning incorrect standardised qualifications	Accreditation being provided too late resulting in accreditation lapsing and stakeholders becoming reaccredited	Accreditation stopped too short resulting in operational delivery ceasing before it should have
Government agencies	Operating process & environment	Education	No education provided resulting in ineffective education and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
Government agencies	Operating process & environment	Enforcement	No enforcement of fines, suspensions, or sanctions resulting in athletes who are doping continuing to dope and perform	Inappropriate enforcement provided resulting in an incorrectly enforced anti-doping system	Enforcement of fines, suspensions, and sanctions being provided late resulting in the continuation of doping and athletes not being sanctioned appropriately.	Enforcement stopped too soon resulting in a lack of enforcement for penalties and athletes doping as a result
Government agencies	Operating process & environment	Fines, suspensions, and sanctions	No fines, suspensions, or sanctions handed down resulting in athletes who are doping continuing to dope and perform	Inappropriate fines, suspensions, or sanctions resulting in continuation of doping	Fines, suspensions, and sanctions being provided late resulting in the continuation of doping	Fines, suspensions, and sanctions are stopped too early and athletes return to sport before they otherwise would have
Government agencies	Operating process & environment	Operating procedures	No standard operating procedures resulting in procedural inconsistency	Inappropriate OPs resulting in incorrect procedural consistency	Operating procedures being provided too late and older and inappropriate procedures are followed as a result	Operating procedures stopped too soon resulting in reliance on outdated procedures for decision making
Government agencies	Operating process & environment	Rules and regulations	No rules and regulations provided resulting in no guidance on anti-doping approaches	Inappropriate rules and regulations provided resulting in incorrect guidance on anti-doping approaches	Rules and regs are provided too late resulting in inadequate guidance and instruction is used.	Rules and regs are applied for too long resulting in the application of inappropriate or unlawful guidance
Government agencies	Operating process & environment	Sample Collection Manual	No sample collection manual provided resulting in guide on how to collect samples	Inappropriate sample collection manual provided resulting in an incorrect guide on how to collect samples	The updated Sample Collection Manual being provided too late resulting in out-of-date collection information being provided and athletes health being put at risk.	Sample Collection Manual stopped too soon resulting in reliance on outdated collection practices for decision making

Government agencies	Operating process & environment	Substance information	No information provided as to new and existing substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Incorrect information provided on substances which are banned resulting in players consuming substances to dope (intentionally or unintentionally)	Substance information being provided too late resulting in out-of-date information being relied on for decision making by stakeholders	Substance information is stopped too soon resulting in incorrect information being provided to stakeholders for decision making
Government agencies	Operating process & environment	TUE Approvals	No TUE approvals being given resulting in athletes who should have these not getting them and being flagged for doping when they should have a TUE	Inappropriate TUE approvals being given resulting in athletes who should not have them and being wrongly allowed use banned substances	TUE approval information being provided too late resulting in athletes testing positive for a substance they actually have a TUE for.	TUE Approvals applied too long resulting in athletes being covered under a TUE for a substance which they no longer use
Operational delivery & management	Operating process & environment	Access	No access to the operating environment to test the athletes resulting in no testing to take place	Inappropriate access provided resulting in no testing to take place	Access being provided too late so that athletes are not able to be tested and testing is missed resulting in athletes not being caught and doping continuing.	Access being stopped too soon resulting in an inability to access facilities for testing procedures and testing not occurring.
Operational delivery & management	Operating process & environment	ADRV Information	No information on athlete doping rule violations being provided and athletes being unaware of the ADVRs	Incorrect information on athlete doping rule violations being provided and athletes being misinformed of the ADVRs	Updated ADRV information being provided too late resulting in athletes and other stakeholders being misinformed with out-of-date information.	ADRV Information stopped too soon resulting in a lack of up-to-date information for stakeholders and reliance on outdated information
Operational delivery & management	Operating process & environment	Communication	No communication between actors in the operating environment resulting in a poor information space and lack of accountability	Inappropriate communication between actors in the operating environment resulting in a poor information space and lack of accountability	Communication being given too late between stakeholders resulting in stakeholders having to rely on inadequate and out-of-date information in decision making and poorer decisions.	Communication stopped too soon resulting in confusion from a lack of clear communication
Operational delivery & management	Operating process & environment	Education	No education provided resulting in ineffective education and an increase in athlete doping	Inappropriate education provided resulting in uneducated stakeholders	Education being provided too late resulting in stakeholders who are relying on out-of-date education information	Education stopped too early resulting in outdated approaches being used
Operational delivery & management	Operating process & environment	Enforcement	No enforcement of fines, suspensions, or sanctions resulting in athletes who are doping continuing to dope and perform	Inappropriate enforcement provided resulting in an incorrectly enforced anti-doping system	Enforcement of fines, suspensions, and sanctions being provided late resulting in the continuation of doping and athletes not being sanctioned appropriately.	Enforcement stopped too soon resulting in a lack of enforcement for penalties and athletes doping as a result

Operational delivery & management	Operating process & environment	Event/venue requirements	No event/venue requirements communicated resulting in no understanding of what is required to allow testing/anti-doping practises	Inappropriate event/venue requirements communicated resulting in incorrect understanding of what is required to allow testing/anti-doping practises	The event/venue requirements not being communicated with enough time to facilitate testing/anti-doping practices resulting in missed or poorer quality testing procedures.	Event/venue requirements information stopped too soon resulting in an inability to access facilities for testing procedures and testing not occurring.
Operational delivery & management	Operating process & environment	Fines, suspensions, and sanctions	No fines, suspensions, or sanctions handed down resulting in athletes who are doping continuing to dope and perform	Inappropriate fines, suspensions, or sanctions resulting in continuation of doping	Fines, suspensions, and sanctions being provided late resulting in the continuation of doping	Fines, suspensions, and sanctions are stopped too early, and athletes return to sport before they otherwise would have
Operational delivery & management	Operating process & environment	Operating procedures	No standard operating procedures resulting in procedural inconsistency	Inappropriate OPs resulting in incorrect procedural consistency	Operating procedures being provided too late and older and inappropriate procedures are followed as a result	Operating procedures applied too long resulting in outdated practices relied upon for decision making
Operational delivery & management	Operating process & environment	Rules and regulations	No rules and regulations provided resulting in no guidance on anti-doping approaches	Inappropriate rules and regulations provided resulting in incorrect guidance on anti-doping approaches	Rules and regs are provided too late resulting in inadequate guidance and instruction is used.	Rules and regs are applied for too long resulting in the application of inappropriate or unlawful guidance
Operating environment		Oversight	Overseeing of athlete and support staff requirements and/or procedures is not provided leading to intentional or unintentional incorrect behaviours	Inadequate overseeing of athletes and support staff leading to intentional or unintentional incorrect behaviours	Oversight provided too late leading to athletes and support staff having already committed incorrect behaviours/actions	Oversight stopped too soon leading to incorrect actions and behaviours of athletes and support staff
Operating environment		Information about rules & regulations	No information provided leading to poorly informed athletes who could breach rules and regulations	Incorrect information provided on rules and regs leading to misinformed athletes who could breach rules and regs	Information provided too late leading to athletes having already breached required rules and regs	Information on rules and regs provided for too long leading to outdated information being passed on
Operating environment		Social controls (verbal/nonverbal)	Social controls not provided resulting in no set of social rules and standards around doping or anti-doping	Inappropriate social controls provided resulting in incorrect social rules and standards for doping and anti-doping	Social controls provided too late to have any impact around rules and standards to doping and anti-doping	Social controls applied to long resulting in outdated social rules and standards towards doping and anti-doping

Appendix 3. STPA analysis for the feedback identified in the STAMP control structure model (Part Three)

From	To	Feedback	Action required but not provided	Unsafe action provided	Incorrect/timing order	Stopped too soon/applied too long
	Operating environment	Verbal/nonverbal communication	No communication provided resulting in no information sharing around doping and anti-doping among athletes and support staff	Inappropriate communication provided leading to inadequate information sharing around doping and anti-doping among athletes and support staff	Communication provided too late leading to delayed among athletes and support staff	Communication stopped too soon leading to reduced information sharing around doping and anti-doping among athletes and support staff
	Operating environment	Samples	No samples provided resulting in an inability to test athletes and athletes not being tested and caught while they continue to dope	Inaccurate samples collected resulting in worsening performance of testing as athletes are notified of false positive and negative results	Samples provided too late and are not tested in time to capture doping leading to athletes continuing to dope.	Samples being collected too soon resulting in the athlete beginning doping after the sample collection period
Operating process & environment	Local management & supervision	Education attendance data	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education attendance data provided leading to an inaccurate understanding of who has been attending education	Education attendance data provided too late to accurately capture stakeholders who attended	Education attendance data recording stopped too soon and attendees are not recorded leading to them being viewed as uneducated
Operating process & environment	Local management & supervision	Evaluation	No evaluation provided leading to an inability to evaluate stakeholders' decisions	Inappropriate evaluation of stakeholders leading to an inability to detect poor decisions	Evaluation provided too late to detect poor decisions which occurred prior to evaluation which resulted in worsening outcomes	Evaluation stopped too soon to conduct a thorough evaluation leading to decisions made on limited evidence
Operating process & environment	Local management & supervision	Integrity complaints	No integrity complains provided resulting in an inability to determine if stakeholders are acting with integrity	Inappropriate integrity complaints provisions resulting in an inability to detect integrity issues	Integrity complaints provided too late to detect and resolve integrity issues leading to worsening outcomes	Integrity complaints applied for too long that they are no longer valid
Operating process & environment	Local management & supervision	Social Controls	No social controls provided resulting in athletes continuing to dope without the guidance of their social group not to dope	Inappropriate social controls resulting in athletes undertaking doping as they believe there is social pressure and approval to do so	Social controls provided too late leading to increased normalisation of doping attitudes and increased doping	Social controls stopped too soon leading to normalisation of doping attitudes without supervision

Local management & supervision	Operational deliveryery & management	Data & statistics	No data and statistics provided leading to in inability to track progress and compliance	Inaccurate data & statistics provided which leads to an incorrect understanding of progress and compliance outcomes	Data & statistics provided too early to capture new trends in testing and doping	Data & statistics stopped too soon leading to inability to capture new data and trends in testing and doping
Local management & supervision	Operational deliveryery & management	Education auditing	No education auditing data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education auditing data provided leading to an inaccurate understanding of who has been attending and completing education	Education auditing undertaken too late and stakeholder attendance not accurately captures resulting in a decrease in education	Education auditing stopped too soon leading to an inability to detect whether education is leading to improved outcomes
Local management & supervision	Operational deliveryery & management	Equipment compliance reports	No equipment compliance reports provided resulting in the use of potentially broken or poorly maintained equipment	Inaccurate equipment compliance reports provided resulting in an inability to understand which equipment is compliant or faulty	Equipment compliance reports undertaken too late resulting in faulty equipment being used leading too inaccurate results	Equipment compliance reports stopped being recorded too soon and compliance failures are missed as a result
Local management & supervision	Operational deliveryery & management	Medical records	No medical records provided resulting in a lack of information being provided as to the current health state of the athlete	Inaccurate medical records provided resulting in a poor understanding of athletes current and past medical needs and poorer health outcomes	Medical records provided too late resulting in an inaccurate medical history and current medical needs	Medical records are applied too long resulting in out-of-date records and guidance being used to make medical decisions
Local management & supervision	Operational deliveryery & management	Policy Complaints	No policy complaints provided resulting in an inability to determine if stakeholders are adhering to policy	Inaccurate policy complaint information resulting in deteriorating conditions and outcomes as policy issues are not known or rectified	Policy complaints provided too late to effect change in policy resulting in poorer outcomes for stakeholders	Policy complaints are stopped too soon to reach critical mass which would influence the policy agenda
Local management & supervision	Operational deliveryery & management	Public opinion	No public views, attitudes, and beliefs regarding doping resulting in no understanding of societal sentiment	N/A	Public opinion is provided too late to influence outcomes and decision making deteriorates as a result.	N/A
Local management & supervision	Operational deliveryery & management	Supplement Independent Testing	No supplement independent testing provided resulting in potentially tainted supplements being given and consumed	Inaccurate Supplement Independent Testing resulting in potentially tainted supplements being approved and consumed	Supplement Independent Testing is provided too late and potentially tainted supplements are consumed before testing and approval	Supplement Independent Testing is stopped too soon, and supplements are not tested leading to inadvertent doping
Local management & supervision	Operational deliveryery & management	Supplement register	No supplement register provided leading to inability to track which supplements athletes are tracking and supplement information	Inaccurate supplement register resulting in an inability to track the supplements an athlete is consuming and increased likelihood	Supplement register provided too early to accurately reflect what the athlete is consuming and an inability to monitor this as a result.	Supplement register is stopped too soon resulting in an inability to track which supplements athletes are using and to potential doping

				of an athlete consuming a tainted supplement with no record		
Local management & supervision	Operational deliveryery & management	TUE Applications	No TUE applications provided resulting in athletes testing positive when they should have had a TUE	Inaccurate TUE Application submitted leading to the athlete not being covered by the TUE and potentially testing positive as a result	TUE Applications are given too late, and athletes are not covered by the TUE they applied for and trigger a positive test as a result	TUE Applications are stopped too soon leading to athletes not being able to access TUE's when they need to
Operational deliveryery & management	Government agencies	Advocacy	No advocacy provided so stakeholders are not advocated for, and their feedback is not heard	Inappropriate advocacy is provided leading to worsening outcomes for stakeholders as their needs are not met	Advocacy provided too late leading to stakeholder feedback not being provided and integrated to improve outcomes	Advocacy stopped too soon leading to stakeholders not being advocated for and their needs being unmet
Operational delivery & management	Government agencies	Compliance Outcomes	No compliance outcomes provided so stakeholders unaware of if they are compliant with current guidance	Inappropriate compliance outcomes communicated leading to confusion about whether stakeholders are compliant with up-to-date guidance	Compliance outcomes are provided too late, and compliance deteriorates as a result of less monitoring	Compliance Outcomes recordings stopped too soon leading to inability to determine current compliance outcomes and inaccurate guidance resulting
Operational delivery & management	Government agencies	Education attendance data	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education attendance data provided leading to an inaccurate understanding of who has been attending education	Education attendance data provided too late to accurately capture stakeholders who attended	Education attendance data recording stopped too soon, and attendees are not recorded leading to them being viewed as uneducated
Operational delivery & management	Government agencies	Registration & licensing data	No registration & licensing data provided resulting in an inability to determine who is registered to provide services to stakeholders	Inaccurate registration & licensing data provided leading to confusion as to which stakeholders are appropriately registered to provide services	Registration & licensing data provided too late leading to an inaccurate understanding of stakeholders who hold valid registration and licenses	Registration & licensing data collected stopped too soon leading to stakeholders becoming unregistered or unlicensed to undertake their roles
Operational delivery & management	Government agencies	Financial reporting	No financial reporting provided resulting in an inability to determine the current state of financial use and budgeting	Inaccurate financial reporting provided resulting in a lack of understanding and confusion as to the current financial situation for stakeholders	Financial reporting provided too late resulting in inaccurate financial information being used by decision makers and worsening outcomes	Financial reporting stopped too soon leading to decisions being made on an inaccurate financial basis and worsening financial outcomes
Operational delivery & management	Government agencies	Laboratory reporting	No laboratory reporting is provided resulting in an inability to determine if laboratories are	Inaccurate laboratory reporting is provided resulting in athletes receiving incorrect guidance as to their current doping status.	Laboratory reporting provided too late leading to a lack of accurate testing capacity information	Laboratory reporting stopped too soon leading to laboratories being used which do not provide accurate testing information

			compliant with the latest guidance and testing procedures			
Operational delivery & management	Government agencies	Laboratory Results Reporting	No laboratory results reporting is provided resulting in an inability to determine if laboratories are conducting testing which reflects the guidance	Inaccurate laboratory results reporting is provided resulting in athletes receiving incorrect guidance as to their current doping status.	Laboratory results reporting provided too late leading to athletes continuing to perform while they have tested positive	Laboratory Results Reporting stopped too soon leading to updated results not being communicated to stakeholders and decisions being made on athlete and team selection using inaccurate information
Operational delivery & management	Government agencies	Performance reporting	No performance reporting is provided resulting in an inability to determine if operational deliverer is compliant with the latest guidance and procedures	Inaccurate performance reporting leading to inability to detect worsening performance for stakeholders	Performance reporting provided too late leading to in inaccurate understanding of actual performance of stakeholders amid worsening performance	Performance reporting being stopped too soon leading to an inability to provide up to date information on performance to stakeholders and declining performance
Operational delivery & management	Government agencies	Policy Complaints	No policy complaints provided resulting in an inability to determine if stakeholders are adhering to policy	Inaccurate policy complaint information resulting in deteriorating conditions and outcomes as policy issues are not known or rectified	Policy complaints provided too late to effect change in policy resulting in poorer outcomes for stakeholders	Policy complaints are stopped too soon to reach critical mass which would influence the policy agenda
Operational delivery & management	Government agencies	Public opinion	No public views, attitudes, and beliefs regarding doping resulting in no understanding of societal sentiment	N/A	Public opinion is provided too late to influence outcomes and decision making deteriorates as a result.	N/A
Operational delivery & management	Government agencies	Research proposals	No research proposals provided so new research isn't undertaken and new ideas aren't introduced and tested	Inappropriate research proposals provided leading to research being funded which doesn't address fundamental questions	Research proposals provided too late and are not funded leading to a lack of appropriate research	Research proposals applied too long leading to the research questions becoming redundant and no longer novel
Operational delivery & management	Government agencies	Research reports and findings	No research reports and findings are provided so practices are not updated to reflect changing trends and conditions	Inaccurate research reports and findings provided leading to stakeholders not being able to determine changing trends or conditions	Research reports and findings are provided too late to influence policy changes and outcomes for stakeholders	Research reports and findings stopped too soon leading to an inability to influence current practice and a gap in capacity

Operational delivery & management	Government agencies	Whereabouts	No whereabouts provided resulting in an inability to determine athlete whereabouts to test and a deterioration in testing capacity.	Inaccurate whereabouts information provided resulting in incorrect knowledge of athlete whereabouts and declining testing capacity	Whereabouts information provided too late leading to an athlete not being where they identified they would be an a whereabouts violation	Whereabouts stopped too soon leading to an inability to determine where athletes are for testing and resulting in missing doping tests
Government agencies	Parliament and legislatures	Advocacy & lobbying	No advocacy provided so stakeholders are not advocated for, and their opinions are not heard	Inappropriate advocacy is provided leading to worsening outcomes for stakeholders as their needs are not met	Advocacy provided too late leading to stakeholders not being lobbied for and support not being provided and integrated to improve outcomes	Advocacy stopped too soon leading to stakeholders not being advocated for and their needs being unmet
Government agencies	Parliament and legislatures	Draft legislation	No Draft legislation given so legislation does not renew and becomes outdated and no longer provides current guidance	Inappropriate draft legislation given resulting in the legislation not being effective in deterring or detecting doping activities	Draft legislation provided too late resulting in new legislation not being drafted and it not being implemented	Draft legislation applied too long so that it no longer reflects the current needs of stakeholders and is current
Government agencies	Parliament and legislatures	Financial reporting	No financial reporting provided resulting in an inability to determine the current state of financial use and budgeting	Inaccurate financial reporting provided resulting in a lack of understanding and confusion as to the current financial situation for stakeholders	Financial reporting provided too late resulting in inaccurate financial information being used by decision makers and worsening outcomes	Financial reporting stopped too soon leading to decisions being made on an inaccurate financial basis and worsening financial outcomes
Government agencies	Parliament and legislatures	Government reports	No governmental reports provided leading to less oversight and deteriorating standards	Inaccurate government reports provided resulting in policy development which doesn't reflect the underlying conditions and worsening outcomes for stakeholders	Government reports being provided too late to influence policy and worsening outcomes	Government reports are applied too long resulting in outdated guidance being used for decision making
Government agencies	Parliament and legislatures	Policy development	No policy development given so policy becomes outdated and no longer provides current guidance	Inappropriate policy development provided leading to policies which are not effective and worsening outcomes for stakeholders	Policy development being implemented too early and updated policy not reflecting the current needs of stakeholders	Policy development is stopped too soon and over time the policy starts to disentangle from the needs of stakeholders
Government agencies	Parliament and legislatures	Research proposals, reports, and findings	No research proposals, reports, and findings provided so new research is not undertaken, research findings are not communicated, and new ideas aren't introduced and tested	Inaccurate research proposals, reports and findings provided leading to stakeholders not being able to determine changing trends or conditions	Research proposals, reports, and findings are provided too late to influence policy changes and outcomes for stakeholders	Research proposals, reports, and findings stopped too soon leading to an inability to influence current practice and a gap in capacity

Government agencies	Parliament and legislatures	Sanction data & statistics	No sanction data & statistics provided leading to an inability to track trends in testing and doping rates	Inaccurate sanction data & statistic leading to making guidance that does not improve outcomes for stakeholders	Sanction data & statistics being provided too late resulting in policies which do not address the accurate state of current sanctions	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes whose sanctions should have finished.
Government agencies	Parliament and legislatures	Senate estimates briefings	No Senate estimates briefings provided resulting in a lack of governmental oversight into current practices and guidance	Inaccurate Senate estimates briefings provided resulting in a lack of governmental oversight to the real underlying condition of current practice and guidance	Senate estimates briefings being provided too early resulting in a lack of accurate oversight on changes in conditions for stakeholders	Senate estimates briefings stopped too soon resulting in a lack of information being provided and a lack of appropriate oversight as to the current situation
Parliament and legislatures	International influence	Advocacy & lobbying	No advocacy provided so stakeholders are not advocated for, and their opinions are not heard	Inappropriate advocacy is provided leading to worsening outcomes for stakeholders as their needs are not met	Advocacy provided too late leading to stakeholders not being lobbied for and support not being provided and integrated to improve outcomes	Advocacy stopped too soon leading to stakeholders not being advocated for and their needs being unmet
Parliament and legislatures	International influence	Financial reporting	No financial reporting provided resulting in an inability to determine the current state of financial use and budgeting	Inaccurate financial reporting provided resulting in a lack of understanding and confusion as to the current financial situation for stakeholders	Financial reporting provided too late resulting in inaccurate financial information being used by decision makers and worsening outcomes	Financial reporting stopped too soon leading to decisions being made on an inaccurate financial basis and worsening financial outcomes
Parliament and legislatures	International influence	Government reports	No governmental reports provided leading to less oversight and deteriorating standards	Inaccurate government reports provided resulting in policy development which doesn't reflect the underlying conditions and worsening outcomes for stakeholders	Government reports being provided too late to influence policy and worsening outcomes	Government reports are applied too long resulting in outdated guidance being used for decision making
Parliament and legislatures	International influence	Research proposals, reports, and findings	No research proposals, reports, and findings provided so new research is not undertaken, research findings are not communicated, and new ideas aren't introduced and tested	Inaccurate research proposals, reports and findings provided leading to stakeholders not being able to determine changing trends or conditions	Research proposals, reports, and findings are provided too late to influence policy changes and outcomes for stakeholders	Research proposals, reports, and findings stopped too soon leading to an inability to influence current practice and a gap in capacity
Parliament and legislatures	International influence	Sanction data & statistics	No sanction data & statistics provided leading to an inability to track trends in testing and doping rates	Inaccurate sanction data & statistic leading to the making of guidance that does not improve current conditions and outcomes for stakeholders	Sanction data & statistics being provided too late resulting in policies which do not address the accurate state of current sanctions	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes whose sanctions should have finished.

Operating process & environment	International influence	International governing association's whereabouts	No whereabouts provided resulting in an inability to determine athlete whereabouts to test and a deterioration in testing capacity.	Inaccurate whereabouts information provided resulting in incorrect knowledge of athlete whereabouts and declining testing capacity	Whereabouts information provided too late leading to an athlete not being where they identified they would be a whereabouts violation	Whereabouts stopped too soon leading to an inability to determine where athletes are for testing and resulting in missing doping tests
Operating process & environment	International influence	Auditing	No auditing provided resulting in an inability to understand the current state of practice and guidance and deteriorating standards	Inaccurate auditing resulting in information being used that does not reflect the accurate state of practice leading to deteriorating standards	Auditing being undertaken too late to capture the current state of practice which leads to worsening outcomes	Auditing being stopped too soon resulting in a lack of up-to-date information being available for decision making
Operating process & environment	Operational delivery & management	Education attendance data	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education attendance data provided leading to an inaccurate understanding of who has been attending education	Education attendance data provided too late to accurately capture stakeholders who attended	Education attendance data recording stopped too soon, and attendees are not recorded leading to them being viewed as uneducated
Operating process & environment	Operational delivery & management	Education auditing	No education auditing data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education auditing data provided leading to an inaccurate understanding of who has been attending and completing education	Education auditing undertaken too late and stakeholder attendance not accurately captures resulting in a decrease in education	Education auditing stopped too soon leading to an inability to detect whether education is leading to improved outcomes
Operating process & environment	Operational delivery & management	Integrity complaints	No integrity complains provided resulting in an inability to determine if stakeholders are acting with integrity	Inappropriate integrity complaints provisions resulting in an inability to detect integrity issues	Integrity complaints provided too late to detect and resolve integrity issues leading to worsening outcomes	Integrity complaints applied for too long that they are no longer valid
Operating process & environment	Operational delivery & management	Policy Complaints	No policy complaints provided resulting in an inability to determine if stakeholders are adhering to policy	Inaccurate policy complaint information resulting in deteriorating conditions and outcomes as policy issues are not known or rectified	Policy complaints provided too late to effect change in policy resulting in poorer outcomes for stakeholders	Policy complaints are stopped too soon to reach critical mass which would influence the policy agenda
Operating process & environment	Operational delivery & management	Samples	No samples provided resulting in an inability to test athletes and athletes not being tested and caught while they continue to dope	Inaccurate samples collected resulting in worsening performance of testing as athletes are notified of false positive and negative results	Samples provided too late and are not tested in time to capture doping leading to athletes continuing to dope.	Samples being collected too soon resulting in the athlete beginning doping after the sample collection period

Operating process & environment	Government agencies	Audit results	No audit results provided resulting in an inability to understand the current state of practice and guidance and deteriorating standards	Inaccurate audit results presented resulting in information being used that does not reflect the accurate state of practice leading to deteriorating standards	Audit results communicated too late to capture the accurate state of practice resulting in reliance on inaccurate information for decisions	Audit results communication being applied to late resulting in out-of-date information being relied upon by stakeholders
Operating process & environment	Government agencies	Policy Complaints	No policy complaints provided resulting in an inability to determine if stakeholders are adhering to policy	Inaccurate policy complaint information resulting in deteriorating conditions and outcomes as policy issues are not known or rectified	Policy complaints provided too late to effect change in policy resulting in poorer outcomes for stakeholders	Policy complaints are stopped too soon to reach critical mass which would influence the policy agenda
Operating process & environment	Government agencies	TUE Applications	No TUE applications provided resulting in athletes testing positive when they should have had a TUE	Inaccurate TUE Application submitted leading to the athlete not being covered by the TUE and potentially testing positive as a result	TUE Applications are given too late, and athletes are not covered by the TUE they applied for and trigger a positive test as a result	TUE Applications are stopped too soon leading to athletes not being able to access TUE's when they need to
Operating process & environment	Government agencies	Whistleblowing	No whistleblowing undertaken resulting in integrity issues not being reported as they should be and incorrect or illegal practices continuing.	Inappropriate whistleblowing complaints made leading to the use of investigative resources which do not improve outcomes for stakeholders	Whistleblowing is undertaken too late leading to integrity issues not being captured accurately at the time and worsening outcomes	Whistleblowing be stopped too soon and there being a resulting lack of pressure by decision makers to improve outcomes
Local management & supervision	Government agencies	Audit results	No audit results provided resulting in an inability to understand the current state of practice and guidance and deteriorating standards	Inaccurate audit results presented resulting in information being used that does not reflect the accurate state of practice leading to deteriorating standards	Audit results communicated to late to capture the accurate state of practice resulting in reliance on inaccurate information for decisions	Audit results communication being applied to late resulting in out-of-date information being relied upon by stakeholders
Local management & supervision	Government agencies	Education attendance data	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education attendance data provided leading to an inaccurate understanding of who has been attending education	Education attendance data provided too late to accurately capture stakeholders who attended	Education attendance data recording stopped too soon and attendees are not recorded leading to them being viewed as uneducated
Local management & supervision	Government agencies	TUE Applications	No TUE applications provided resulting in athletes testing positive when they should have had a TUE	Inaccurate TUE Application submitted leading to the athlete not being covered by the TUE and potentially testing positive as a result	TUE Applications are given too late, and athletes are not covered by the TUE they applied for and trigger a positive test as a result	TUE Applications are stopped too soon leading to athletes not being able to access TUE's when they need to

Local management & supervision	Government agencies	Whistleblowing	No whistleblowing undertaken resulting in integrity issues not being reported as they should be and incorrect or illegal practices continuing.	Inappropriate whistleblowing complaints made leading to the use of investigative resources which do not improve outcomes for stakeholders	Whistleblowing is undertaken too late leading to integrity issues not being captured accurately at the time and worsening outcomes	Whistleblowing be stopped too soon and there being a resulting lack of pressure by decision makers to improve outcomes
Operational delivery & management	Parliament and legislatures	Advocacy	No advocacy provided so stakeholders are not advocated for, and their opinions are not heard	Inappropriate advocacy is provided leading to worsening outcomes for stakeholders as their needs are not met	Advocacy is provided too late, and stakeholders are not advocated for, and their outcomes worsen in the intervening period	Advocacy stopped too soon leading to stakeholders not being advocated for and their needs being unmet
Operational delivery & management	Parliament and legislatures	Public opinion	No public views, attitudes, and beliefs regarding doping resulting in no understanding of societal sentiment	N/A	Public opinion is provided too late to influence outcomes and decision making deteriorates as a result.	N/A
Operational delivery & management	Parliament and legislatures	Research reports and findings	No research reports and findings are provided so practices are not updated to reflect changing trends and conditions	Inaccurate research reports and findings provided leading to stakeholders not being able to determine changing trends or conditions	Research reports and findings are provided too late to influence policy changes and outcomes for stakeholders	Research reports and findings stopped too soon leading to an inability to influence current practice and a gap in capacity
Operational delivery & management	Parliament and legislatures	Sanction data & statistics	No sanction data & statistics provided leading to an inability to track trends in testing and doping rates	Inaccurate sanction data & statistic leading to the making of guidance that does not improve current conditions and outcomes for stakeholders	Sanction data & statistics being provided too late resulting in policies which do not address the accurate state of current sanctions	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes who's sanctions should have finished.
Operational delivery & management	International influence	Education attendance data	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education attendance data provided leading to an inaccurate understanding of who has been attending education	Education attendance data provided too late to accurately capture stakeholders who attended	Education attendance data recording stopped too soon and attendees are not recorded leading to them being viewed as uneducated
Operational delivery & management	International influence	Research reports and findings	No research reports and findings are provided so practices are not updated to reflect changing trends and conditions	Inaccurate research reports and findings provided leading to stakeholders not being able to determine changing trends or conditions	Research reports and findings are provided too late to influence policy changes and outcomes for stakeholders	Research reports and findings stopped too soon leading to an inability to influence current practice and a gap in capacity

Operational delivery & management	International influence	Sanction data & statistics	No sanction data & statistics provided leading to an inability to track trends in testing and doping rates	Inaccurate sanction data & statistic leading to the making of guidance that does not improve current conditions and outcomes for stakeholders	Sanction data & statistics being provided too late resulting in policies which do not address the accurate state of current sanctions	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes whose sanctions should have finished.
Government agencies	International influence	Auditing	No auditing provided resulting in an inability to understand the current state of practice and guidance and deteriorating standards	Inaccurate auditing resulting in information being used that does not reflect the accurate state of practice leading to deteriorating standards	Auditing being undertaken too late to capture the current state of practice which leads to worsening outcomes	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes whose sanctions should have finished.
Government agencies	International influence	Compliance Outcomes	No compliance outcomes provided so stakeholders unaware of if they are compliant with current guidance	Inaccurate compliance outcomes provided leading to a lack of clarity as to the accurate state of stakeholder's compliance with guidance	Compliance outcomes are provided too late, and compliance deteriorates as a result of less monitoring	Compliance Outcomes recordings stopped too soon leading to inability to determine current compliance outcomes and inaccurate guidance resulting
Government agencies	International influence	Education data & statistics	No education attendance data provided resulting in an inability to determine who is attending education and compliant with current education requirements	Inaccurate education data & statistics provided leading to an inaccurate understanding of who has been attending and completing education	Education data & statistics are provided too late to accurately capture who is attending education leading to worsening education outcomes	Education data & statistics being stopped too long resulting in an inability to track accurate education data and compliance
Government agencies	International influence	Investigation Reporting	No investigation reporting provided resulting in an inability to detect dopers through investigative practices and athletes continuing to dope without detection	Inaccurate investigative reporting leading to investigations which do not target actual underlying issues and a waste of resources	Investigative reporting is undertaken too early and does not capture when athletes are doping leading to an inaccurate view of current state of doping practice	Investigative reporting being stopped too soon resulting in an inability to catch and detect athletes who dope and their suppliers
Government agencies	International influence	Research reports and findings	No research reports and findings are provided so practices are not updated to reflect changing trends and conditions	Inaccurate research reports and findings provided leading to stakeholders not being able to determine changing trends or conditions	Research reports and findings are provided too late to influence policy changes and outcomes for stakeholders	Research reports and findings stopped too soon leading to an inability to influence current practice and a gap in capacity
Government agencies	International influence	Sanction data & statistics	No sanction data & statistics provided leading to an inability to track trends in testing and doping rates	Inaccurate sanction data & statistic leading to the making of guidance that does not improve current conditions and outcomes for stakeholders	Sanction data & statistics being provided too late resulting in policies which do not address the accurate state of current sanctions	Sanction data & statistics being applied too long resulting in sanctions being applied for athletes whose sanctions should have finished.

Government agencies	International influence	Testing and collection (NADOs)	Testing and collection of samples is not undertaken in foreign countries by the relevant NADO, resulting in athletes not being tested and continuing to dope	Inaccurate testing and collection resulting in athletes not being tested as they should be and continuing to dope as their tests are missed.	Testing and collection being provided too late, and athletes are not tested as a result leading to increased doping	Testing and collection being stopped too soon resulting in an inability to catch and detect athletes who dope and continuation of doping practices
Government agencies	International influence	TUE Outcomes	No TUE Outcomes provided resulting in TUE applications not being approved and athletes who would otherwise have a TUE being detected as doping	Inaccurate TUE Outcomes being provided resulting in athletes being approved for a TUE they are not using and being detected for a substance they are using but not covered for.	TUE Outcomes being provided too late resulting in athletes unsure about if they have a TUE and withdrawing from competition as a result.	TUE Outcomes being applied too long resulting in TUEs that cover athletes for longer than necessary and tacit approval to use those substances for purposes other than medical need.