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Perceptions of anti-doping scientific work

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INTRODUCTION

In the 40 or so years that scientists have been involved in doping control work much has been achieved in anti-doping science. However, both scientists working in accredited anti-doping laboratories and other anti-doping workers such as those connected with the World Anti-Doping Agency (WADA) and the national anti-doping agencies, the International Olympic Committee (IOC), sporting federations such as the International Association of Athletics Federations (IAAF), athletes, coaches, sports physicians, sports lawyers and journalists recognize that much remains to be achieved. This paper reports on further progress in a study of the work of anti-doping scientists and the way that these scientists maintain their expertise through the generation and mobilization of new knowledge. The data for this research has been collected through accessing publicly available documentation, observation, surveys and interviews with members of the various stakeholder groups listed above. The picture that emerges from the data affirms the past contributions of anti-doping scientists, sets out the current expectations of their stakeholders and outlines the characteristics that the "ideal" scientific director needs to meet the future demands of anti-doping scientific work. The paper also considers the dynamic function of the annual Cologne Workshop on Dope Analysis in the development of anti-doping science and enunciates some emerging issues that challenge the anti-doping scientific community as it grapples with both the changing science and the evolving context of their complex socio-technical work.

STAKEHOLDER PERCEPTIONS OF ANTI-DOPING SCIENTIFIC WORK

Whilst scientists in the popular media are portrayed as nerds, absent minded professors, sleuths or heroes, our study has built a rich and much more grounded description of stakeholder perceptions of the contribution of the antidoping laboratories and their scientific directors to doping control efforts. One stakeholder described anti-scientific work as a "battleground where the lines are clearly drawn and … both sides (are) trying to do the exact opposite of each other"

(ID: S015)*. Such words invoke images of a conflict where skilled warriors from each side use well-honed weapons to counter the efforts of their opponents. The appropriateness or otherwise of this image will become apparent as we describe stakeholder perceptions of the past, current and future nature of scientific work in doping control in sport.

Past contributions of Scientific Directors of Anti-doping Laboratories

Stakeholders were asked about the contributions of the scientific directors to doping control in sport. As reported elsewhere [1], stakeholder answers varied.

Stakeholders described the scientific directors as "revered as people that have a set of knowledge that only they have" (ID: S021). The contribution of the late Professor Manfred Donike was foundational and his unexpected death left a leadership vacuum in the anti-doping scientific community (ID: S031). Nonetheless, the directors provided leadership in anti-doping work through their passion for what they do. They were seen as being collegial, cooperative and collaborative, as having integrity and their own ethics, which sets them apart, as trustworthy and reliable. One stakeholder commented that "by and large, you can trust the whole lot" (ID: S027). Another stakeholder was aware that the scientific directors have worked in difficult financial situations that are not "really economically viable … (as) … there isn't enough money in (anti-doping scientific work) for it to be big business" (ID: S016). The directors have had to "rely on scandals to force groups to spend money on doping issues" (ID: S015) and have built "the scientific background and framework" (ID: S015) for doping control work through many unappreciated small advances as they "pushed and pushed and pushed and pushed to get (doping control) up to speed" (ID: S015). Other stakeholders described the work of the laboratories as "largely invisible" (ID: S008), and occasionally as getting "the bad press" (ID: S010). Even though the directors have also provided education and ongoing support to policy development and anti-doping workers on an ongoing basis (ID: S015) they had failed "to convince IOC and others of the need to spend the money to develop an effective and comprehensive approach to testing" (ID: S015). In spite of this, stakeholders regarded the role of the accredited laboratories as pivotal in anti-doping work: : "If the lab can't detect substances then we've got no anti-doping program" (ID: S021).

Drawing on complexity theory, our interpretation of this data about the past contributions of the scientific directors suggests that, like other social systems, the anti-doping scientific

* In order to accurately identify data sources, all interviewees have been assigned a unique, coded identification number. In the text, data from an interview will be accompanied by a code which indicates the source(s) of the data.

community has responded to its context in an adaptive manner in much the same way as complex natural biological systems evolve in response to their changing environment [2]. Faced with an initial chaotic situation in which athletes died from the abuse of performance enhancing drugs, analytical science offered a means to explore, identify and validate solutions to the problem and led to the complex processes that form a structured, robust practice for doping analysis. As with all dynamic contexts, one problem replaces or joins another and the cycle continues. (Figure 1).

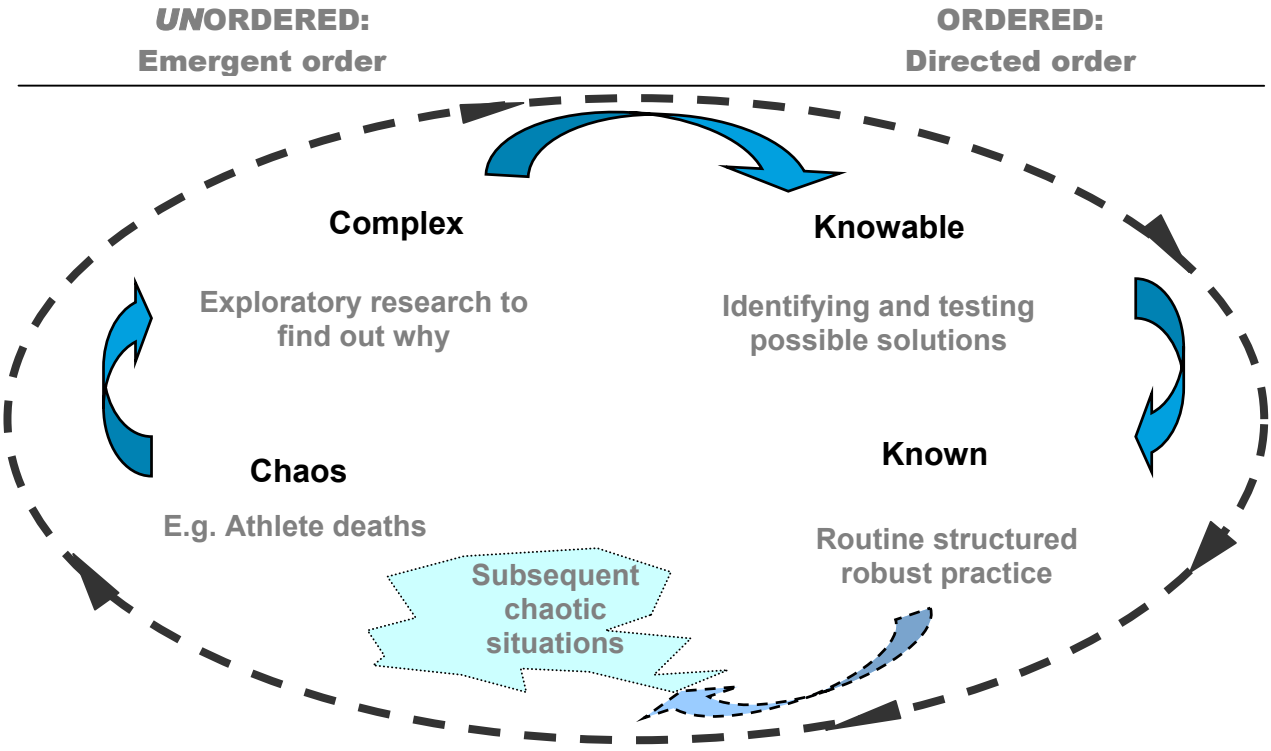

Figure 1: The adaptation of anti-doping science to the complex dynamic context of doping control in sport (This diagram draws on Kurtz and Snowden [3].)

Current expectations of anti-doping scientists

As stated above, stakeholders regard the role of the accredited laboratories as crucial. Anti-doping scientists are expected to behave in an ethical manner both in their day-to-day work and their research. The laboratories are expected to conduct high quality forensic work on a daily basis and do research that "supports anti-doping rather than doping" (ID: S019). The expectation that anti-doping scientists will share their knowledge and research outcomes with each other is set out in WADA's 'International Standard for Laboratories' [4]. Anti-doping scientists are expected to "link up with other bodies of science" (ID: S020) to validate their own work and to "further the research profile of the area and their nation" (ID: S012). Agency stakeholders expect that the laboratories will be the "intelligence providers" (ID: S024), the

"eyes of anti-doping" (ID: S024), in order to enable a tactical response to attempts by athletes and others to improve performance by unacceptable means. This may mean that the role of formal peer review has to be re-considered as "we don't have time for that anymore … the academic community will have to respond" (ID: S023).

Other stakeholders stressed the need for the scientific directors to "accept their obligation to sport and athletes to be independent" (ID: S027, S031). They expected that the scientific directors would "keep the whole approach acceptable within human rights" (ID: S031) and provide "an independent and un-biased view on the field" (ID: S031). To do this, the scientific directors would personally require a "huge degree of honesty" (ID: S027) in order to "earn the trust and confidence of the athletes who have to be absolutely certain that they will not be wrongly accused" (ID: S027). The directors need to "bring to the non-scientist clear indication on what is known, what should be done, and say the truth, the whole truth, not hiding what is not good to see and not to tell" (ID: S031). "If the lab believes they've stuffed up – left a sample open ... spilt coffee over it … they have to be prepared to say so" (ID: S027).

Decision making and policy development are a part of every complex context and the processes surrounding these activities often involve representatives of the multiple perspectives of those who are affected by the context. When asked about the involvement of anti-doping scientists in policy development and decision making in this doping control context, stakeholders held varying views. Expectations about the degree of ranged from very active in policy development and active in the policy development and politics of anti-doping, through general representation on committees that advise policy-making bureaucrats, and representation of specific committees that are concerned with anti-doping science, or simply as knowledge providers to the policy development process because of the need to avoid potential conflicts of interest. These findings had some similarity to the findings of Lach, List, Steel, & Shindler [5] from their study of the advocacy and credibility of ecological scientists in resource decision-making. One stakeholder commented that as part of the "pointy end" (ID: S020) of doping control work, the directors "have a lot that they can bring to bear in terms of how the policy frame needs to work" (ID: S020). The directors' involvement in policy development would "pay dividends" (ID: S020) in terms of how the directors engage in the whole process and improve management of the risks associated with their work if they were "involved in that policy development work as (well,) they would know that they're part of a system; …(they would) understand their role in the system" (ID: S020).

It seems then that the anti-doping scientists, like scientists working in other areas, are expected to carry out their work in a way the conforms to the highest scientific and ethical standards, to be aware of any new approach to their area., and to generate new knowledge that advances doping control work. They are an integral part of a system and need to understand that systematic approach but are not necessarily expected to be involved in the decision making and policy development and decision making that goes on in the area.

The ideal scientific director

In any dynamic field, the skill sets of experts who work in that field are constantly changing. Stakeholders were very aware of the challenges which anti-doping scientists must meet and offered an extensive list of skills and attributes for the 'ideal' director of an accredited anti-doping laboratory.

As well as having an interest in sport, the problem of doping control in sport and the broad needs of doping control programs, their associated rules, testing procedures and protocols, the ideal scientific director would be a "high calibre" (ID: S020), experienced scientist with "impeccable credentials" (ID: S015) in such areas as analytical chemistry, biochemistry, drug metabolism, endocrinology, forensic toxicology, genetics, pharmacology, protein chemistry, and the use of associated instrumentation in order to be able to "fully understand exactly what's going on" (ID: S011). The ideal director would be able to go beyond the routine and have the ability to maintain and extend their own knowledge and that of their staff through research whose outcomes they would be expected to share quickly with other scientists working in the area. The ideal director would have the entrepreneurial skills to raise money for anti-doping research (ID: S023) and preferably have the ability to oversee the research and routine work of experts from other disciplines. The ideal director would be "constantly critical of what they are doing" (ID: S006) and be competent in "quality assurance management" (ID: S020) processes to ensure that WADA's ISL and the ISO17025 standard are met, that laboratory results that are accurate, above suspicion and justifiable (IDS: S002, S011, S020, S025, S031). The ideal director would demonstrate strong organisational, business, financial management and planning skills in order to provide adequate staffing, financial and technical resources, to guarantee the viability and efficiency of the laboratory and to manage scarce resources to maximise the number of tests. The ideal director's supervisory and communication skills would ensure that their own staff was keen and "critically aware at each step of the process that they do" (ID: S006). Staff would "feel that they are contributing to a common aim" (ID: S021). The communication and interpersonal skills of the ideal director

would be able to build and support collaborative networks with scientific colleagues to generate and share knowledge and research outcomes. Additionally, the ideal director would be able to "demystify the technicalities" (ID: S008) for general anti-doping workers, sporting organisations, lawyers, committees, athletes, media, and the public.

The ideal person to appoint as the scientific director would have commitment, dedication, honesty and integrity, and a respect for privacy and confidentiality. The ideal individual would need to be able to handle the stress of conducting the testing for international competitions, handling a high profile positive result, and involvement in court cases. They would need to be pragmatic and have the ability to accept an adverse tribunal outcome as highlighting an area that needs to be addressed [6] and to "live in the 'grey zone' where there is not a lot of black and white" (ID: S015).

As can be seen from the above description, stakeholders' perceptions of the past contributions, current expectations and future behaviours of the scientific directors of accredited laboratories indicate the need for scientific director to possess considerable scientific and managerial credentials, broad contextual knowledge as well as extensive personal attributes including the ability to maintain their own expertise and oversee the creation and mobilisation of new knowledge by the anti-doping scientific community.

MAINTAINING EXPERTISE AND KNOWLEDGE SHARING

Whilst all experts constantly seek knowledge as an integral aspect of maintaining their expertise, for anti-doping scientists working in both the IOC and WADA set in place regulations that required accredited anti-doping laboratories to carry out research that increases the store of knowledge about anti-doping science. Traditionally, scientific discoveries have been disseminated through the peer reviewed literature and attendances at conferences. In this context, the dissemination of new knowledge for its incorporation into laboratory activities is regarded by WADA as something that should happen within a short period of time [4]. The processes of knowledge creation, dissemination and mobilisation as robust laboratory practice are critical for the advancement of doping control and the maintenance of expertise. Data about these processes came from a variety of sources.

Interview data indicates that research and case work are an important means through which new knowledge and skills evolve in the laboratory. The day-to-day work of doping control testing varies considerably between laboratories. According to WADA statistics, in 2003 one laboratory conducted more than 29000 analyses where as another performed just under 200.

New knowledge can also be found in the peer reviewed literature, a source which directors acknowledge as important but hard to find time to access. Given the expectation that the laboratories will advance anti-doping science through their research, we investigated the number of times each scientific director was listed as an author in the published literature for the years 2003 and 2004 by using the PubMed database and the proceedings of the Cologne Workshop. To better understand the variation in this data, we grouped the laboratories according to the number of samples each laboratory had analysed in 2003 (See Table 1).

Table 1: Knowledge sharing: Research publications by laboratory analytical activity

Number of analyses in 2003	Number of laboratories in this group	Number of publications 2003-2004	Average number of publications per laboratory in 2003-2004
0-2400	8	5	0.625
2401-3000	6	21	3.5
3001-6000	8	65	8.125
More than 6001	9	86	14.11

From this table it can be seen that those laboratories with fewer sample numbers tend to have fewer research publications than laboratories with higher samples loads.. Possible reasons for this trend have come from interview data. For example, there is a general lack of funding for doping control work (ID: S016). Some directors expressed concern about the predicament of laboratories where the samples numbers are low. With insufficient income from doping control work to support the laboratory and its staff, the laboratory has a need to access income from other sources (IDs: D002, D004). The associated alternative work and reduced focus upon doping control work may affect the anti-doping research output of the laboratory. Alternatively since work associated with a doping case can provide a stimulus for the need to acquire new knowledge (ID: D006) and thus for research, in laboratories with fewer samples, the lower case work load would most likely result in less case work related stimuli for research.

Many directors indicated that the annual Cologne Workshop was a critical means by which they maintained their expertise. Our observations of the 2003, 2004 and 2005 Cologne Workshops have led to a close examination of the contribution of this event to the evolution of expertise within the anti-doping scientific community. In the preface to the first Cologne Workshop proceedings, the late Professor Manfred Donike [7] reflected that during the previous 10 years the annual gathering at Cologne had grown from “a small Symposium … organized under the participation of the IOC Medical Commission and the Medical

Commission of the IAAF as well as the German Confederation of Sport", had changed its character "because most of the visitors were familiar with the wet chemistry of doping analysis". Donike thanked "all the participants for their contribution and for their input of ideas during the discussion which were hopefully fruitful for both sides" [7].. The following year Donike [8] wrote of the Workshop's information and communication objectives referring to breadth of the topics: improvements in analytical methods, progress in pharmacokinetics and the metabolism of doping agents. The meeting of "delegates from the IOC accredited laboratories, scientists interested in this extending field combining research and routine analysis, and representatives of instrument manufacturers" fostered the exchange of information and broadening of "the scientific basis of doping analysis" and "valuable contributions to the scientific and practical problems of doping analysis."

Over the years the annual Cologne workshop has become a comfortable, regular event for the community of anti-doping scientists where stories are shared, issues discussed and trusted relationships develop and provide a base for other shared activities. The workshop provides a secure, hub-like context to network with others in the field, to expand individual and communal knowledge of the field, to build identity – personal, professional, communal, to change laboratory practice, to present and discuss research as well as to trigger new research projects. An examination of the contents of the published proceedings of the Cologne Workshops indicates that Workshop attendees enjoy a smorgasbord of topics which deal with the evolving multi-faceted nature of anti-doping science. For example, we identified almost 60 papers connected with steroid profiling in the proceedings. Whilst almost 20 of these were published by researchers at the Cologne laboratory, researchers from 21 other laboratories also published their contributions to the area. Similarly there has been an emerging interest in the detection of nandrolone and related substances with 6 papers from the Cologne laboratory and around 12 from other laboratories. The need for accredited laboratories to develop and use tools which enable rapid accurate and economic analyses is evident by the ongoing discussion of the use of instrumentation such as gas chromatography (GC), gas chromatography – mass spectrometry (GC/MS), to high resolution mass spectrometry (HRMS) and GC/MS/MS, the use of high pressure liquid chromatography (HPLC) and liquid chromatography / mass spectrometry / mass spectrometry (LC/MS/MS) as well as the isotope ratio mass spectrometry (IRMS) and more recently time-of-flight TOF instrumentation. Another theme running through the proceedings is that of the dope testing of major sporting events in Africa, Asia, Europe, the Americas, and Oceania. The proceedings also provide an indication of the anti-doping scientific community's concern with other aspects of the work such as the laboratory

automation, sample storage and stability studies, the handling of “unusual” results, the development of reference materials, the WAADS quality assurance program, national doping control programs, in and out of competition testing, litigation, and nutritional supplements.

CONCLUSION

Over the last 40 years, anti-doping scientists played a major role in the development of international and national efforts to combat doping in sport. They have done so with limited resources and are recognised by their stakeholders as experts who are highly motivated, trustworthy, generous and dedicated. The annual Cologne Workshop has provided anti-doping scientists with a regular, secure opportunity to expand their expertise through collaborating in the evolution of anti-doping science work through co-configuration work whereby new ‘knowledge products’ are transferred to everyday use through formal and informal face-to-face peer review and discussion. Co-configuration work “involves building and sustaining a fully integrated system that can sense, respond, and adapt to the individual experience of the customer” [9].. Such work results in goods and services that adapt to the changing needs of the user. Engeström [10] suggests that the heavy demands of successful co-configuration work typically result in partnerships between producer and user and may lead to the development of strategic alliances, or other interdependent set of relationships which collaboratively maintain the complex and evolving integration of products and services over a long period of time. The dialogue between the partners constitutes a real-time feedback process in which new information is interpreted, critiqued, negotiated, synthesised and above all shared within networks of people. Trusted relationships and shared experiences promote the transformation of scientific knowledge into practical doping control programs that operate in the highly charged socio-political context of elite sport. The Cologne Workshop provides a physical and temporal space where the anti-doping scientific community regularly engage in co-configuration work and address dilemmas “which cannot be resolved through separate individual actions alone - but in which joint co-operative actions can push a historically new form of activity into emergence" [11].

The ongoing expansion of relevant scientific knowledge and practice, as indicated by the proceedings of the Cologne Workshop, implies that the anti-doping scientific community is in fact an expert learning community where expert professionals learn as they advance their own and the community’s knowledge base. The dynamic processes of participating in such a community and developing a deep understanding of the field through shared experiences is a key aspect of the social context of scientific work that ensures that knowledge is rapidly and

effectively applied to doping control. These shared co-configuring processes enable the flexible development of capabilities and resources within the community to meet new challenges as they arise and, in particular, to expand the scope of the work as necessary. The challenge that now faces the community is well recognised by both anti-doping scientists and stakeholders. It is the integration, into standard dope testing development, of new techniques which draw upon knowledge areas beyond that currently within the anti-doping scientific community. With the recent increase in funding for scientific research in anti-doping science, it may be strategic and effective for researchers, both within and beyond the accredited laboratories, to draw upon the anti-doping scientific community's known and deeply understood processes of effectively transforming innovative research into routine, cost effective, reliable and robust tests in order to extend the processes of co-configuring research outcomes from other knowledge areas in new ways that reflect continuously changing and complex regulatory regime of doping control.

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