Key performance indicators of the contemporary European academic toxicologist

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Research strategies and needs have evolved tremendously over the past few decades. This has been paralleled by changes in the key performance indicators in the Curriculum Vitae of scientific researchers. In fact, excellence has become a main, if not sole, feature in the track record of high profile academic researchers. Although the specifics of implementation may vary between fields, research excellence is generally dictated by a number of attributes directly related to the principal investigator. In this context, the 3Is, interdisciplinarity, intersectoral experience and internationalization, are now considered indispensable elements in the Curriculum Vitae of young European scientific researchers. Regarding the former, toxicology is a multidisciplinary science, not only using toxicological knowledge as such, but also depending on input from a diversity of other areas, including, but not limited to, physics, chemistry, biology, mathematics, physiology, pathology, epidemiology, statistics and bio-informatics. While it is impossible to be an expert in all these disciplines, a critical toxicologist should be able to identify a lack of expertise and establish complementary collaborations with specialists in these areas accordingly. Furthermore, academic toxicologists should be open to supplementary training at any stage of their career, including achieving the status of European registered toxicologist (ERT). The majority of toxicologists have a background in medical, pharmaceutical, biological or chemical sciences. Most having adopted their toxicology skills through experience or by additional training in the form of toxicology or risk assessment master programmes offered by universities

in many, but not all, European countries. However, training of toxicologists, in particular early-career researchers, should not be restricted to specific or ‘niche’ skills, but must also include a range of transferable skills. The latter have become cornerstones in current doctoral training programmes worldwide. These include organizational and leadership skills, such as those related to management, networking, grant application, gender equality and ethics, as well as communication and interpersonal skills, scientific writing, presenting and publishing.

Academic researchers are increasingly encouraged to move from fundamental research towards more applied studies that serve a direct social or economic purpose. This certainly holds true for the toxicology and adjacent risk assessment area. Indeed, a number of crucial changes in European legislation over the past decade imposed on a number of sectors, in particular the cosmetics field, have restricted or fully banned the use of animals for toxicity testing. This warrants intersectoral collaboration for academic toxicologists, not only with regulatory bodies but equally with industry to develop new alternative methods. Present and future generations of academic toxicologists should be properly prepared to set up valuable partnerships by becoming well acquainted with relevant legislative frameworks and by being trained in areas such as entrepreneurship, marketing and intellectual property rights. These collaborations may open a plethora of opportunities of mutual benefit, such as new sources of research funding and the possibility of initiating joint intersectoral doctoral programmes or secondments for academic toxicology researchers into industry or regulatory agencies.

Contemporary academic toxicologists must be widely visible and active at the European level and beyond. Internationalization can be achieved in a number of ways, among which performing doctoral or postdoctoral research abroad seems most effective. This is considered an asset on the track record of academic scientists and definitely helps to shape the personal and research maturity of young investigators. Another route to international recognition, namely

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publishing in international peer-reviewed journals, still remains a major performance criterion for academics. A number of indicators are used in this respect, such as the h-index, yet the impact factor of the journal still is a frequently used one. In this regard, the impact factors of toxicology journals are lower compared to some neighboring fields, such as pharmacology or cell biology. Nevertheless, academic researchers should strive to publish their work in top 25% or even top 10% of toxicology journals to maximize impact and visibility of their research. Publication of book chapters or editing of books is frequently considered of secondary importance in the academic world. Nonetheless, books allow publication of manuscripts that are less suited for journals, such as in-depth technical protocols, and may help to boost recognition as a field-leading authority. In recent years, social media have emerged as additional and very powerful means of research dissemination. While there is still some skepticism among senior researchers, and although some tools should not be used for professional purposes, young scientists increasingly make use of social media for sharing their work. Social media can be very valuable in advertising or keeping abreast of scientific events. The latter constitutes another major pillar of internationalization. In addition to serving as major platforms for research communication, scientific events, such as conferences, workshops and symposia, are excellent hubs for networking. Several toxicology societies, such as the International Union of

Toxicology (IUTOX), the Society of Toxicology (SOT), the Federation of European Toxicologists and European Societies of Toxicology (EUROTOX) and the European Society of Toxicology In Vitro (ESTIV), organize conferences on a 1-, 2- or 3-yearly basis. Young toxicologists must be encouraged to become involved in such societies as well as in their events, not only as participants, but also as organizers.

It is clear that hallmarks of the Curriculum Vitae of European academic toxicologists have significantly changed over the past years. The future now lies in training young researchers that aspire an academic career in the field of toxicology efficiently to fully meet the 3Is. This not only necessitates a sound and nurturing work and training environment, but vitally a high degree of flexibility from both the trainee and academic supervisor. Coaching the next generation of toxicologists will demand substantial capacity, which might require adaptations to current European training programmes.

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