Written testimony of
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Before the House Committee on Science, Space, and Technology

For the hearing titled:

"Paper Mills and Research Misconduct: Facing the Challenges of Scientific Publishing"

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Representative Foster, and all distinguished members of the committee,

Thank you for the invitation to join the hearing today. I am a conjoint Professor in the Faculty of Medicine and Health at the University of Sydney, Australia, where my area of expertise is the analysis of human genes in cancer and publication integrity. I am honoured to join the committee to discuss current and future challenges in securing the scientific literature from fraudulent academic papers.

Introduction

As Isaac Newton famously stated, scientists see further by standing on the shoulders of giants. When these shoulders are built from unreliable or fraudulent research, progress stalls and the funds that support our best and brightest researchers are wasted.

Paper mills are commercial organisations that allegedly provide undeclared services to authors of scientific and scholarly publications, including fabricated data and manuscripts (1). The threat of paper mills to scientific publishing and integrity has no parallel over my 30-year scientific career. The systematic production of large numbers of fraudulent or fabricated manuscripts harms science, both in its practice and reputation. The scientific literature must take a no-tolerance approach towards papers that may have been constructed solely for career or commercial gain.

Before answering the questions posed by the House Committee, I would like to outline 3 factors that I believe are important in driving the use of paper mills:

(1) Unrealistic publication requirements

Most scientists and academics experience expectations to produce research articles. Pressure to publish becomes problematic when institutions impose publication requirements to either retain academic positions or meet career goals. In some cases, genuine research efforts from academics, students and medical doctors may be insufficient to achieve these requirements. Unrealistic publication quotas that are applied over populations can create large markets for paper mills.

(2) The increasingly commercial focus within scientific and academic publishing

Over the past 20 years, scientific publishing has changed in response to digital publishing and the growing use of author publication fees to generate publisher income. Author-paid publishing has led to a more profit-focussed environment that can reward publication quantity over quality. Digital publishing similarly allows for the publication of more articles, and the creation of new journals that could increasingly compete for the same pools of manuscripts. This is a major issue for scientific fields that produce data through experiments. Research funding has showed limited growth over the past 50 years, and many types of experiments remain difficult, expensive and slow. *While online digital publishing can rapidly expand in response to perceived market forces, the production of experimental results cannot expand with the same speed.* In contrast, paper mills can supply fabricated manuscripts to journals in rates and numbers that experimental scientists cannot produce.

(3) Imbalance between the production and correction of scientific and academic publications

Most systems require an appropriate balance between production and quality control. For example, hospitals rely upon quality cleaning services, and communities require regular waste collection. *Astonishingly, the activities of cleaning and waste removal are largely missing from scientific and academic publishing.* Research funding overwhelmingly supports new knowledge production, and there are comparatively few funds devoted to detecting and correcting published errors. Similarly, scientific and academic publishing focusses upon the publication of new manuscripts, and not on correcting or removing unreliable information. *This imbalance between production and correction means that once fraudulent research is published, it is very difficult to remove from the literature.*

The scope and the ramifications of the presence of fraudulent publications from paper mills within the scientific literature

<u>Key takeaway</u>: In the field of human gene science alone, the number of potentially fraudulent articles could exceed 100,000 original papers. Research is urgently needed to illuminate the history and trajectory of paper mill contributions, so that effective actions can be designed and implemented.

The full **scope** of paper mill contributions to the scientific literature is poorly understood, and likely to be underestimated. We have recently screened just under 12,000 human gene research papers for gene sequence errors that may be associated with paper mill support (2). We identified over 700 papers with errors that could signal paper mill involvement (2). Based on this proportion, the number of paper mill contributions to the human gene literature could exceed 100,000 original articles. This estimate may seem shocking but is likely to be conservative, as (i) paper mills may have been contributing to the human gene research literature for over 15 years across many individual journals, (ii) not all paper mill-supported papers contain the same types of errors, and (iii) some papers could be error-free. As paper mills have also been alleged to have targeted other topics, the total number of paper mill supported publications could be several fold higher. This is supported by research from the Committee on Publication Ethics, where interviewed journals estimated that 2-46% of manuscript submissions could come from paper mills (1).

Given this predicted scale, *research is urgently needed to define the scope of paper mill contributions to the academic literature*. This requires research to identify features of paper mill manuscripts in different fields, and to develop, improve and apply automated detection tools at scale. We need this research to understand how many paper mill-supported articles

have been published, how these articles may have changed over time, and in what direction paper mill manuscripts may be continuing to evolve.

The possible **ramifications** of large number of fraudulent papers from paper mills are very concerning. Human gene research papers with features of possible paper mill involvement are cited by the preclinical and clinical literature (2). This suggests that paper mill articles are *misleading researchers and research directions*. Pursuing fabricated gene research could damage biomedical research careers at all stages, encourage the support of unproductive research directions, slow clinical and industry research translation through opportunity costs, and reduce confidence in research and the scientific method. The challenge of distinguishing genuine and fraudulent publications may cause researchers to abandon particular research fields. Paper mill articles could therefore decrease publication outputs from genuine research, compounding their damaging effects on scientific progress.

How we have used automation to identify fraud, and how we anticipate automation being used in the future to either combat fraud or to perpetuate it

Key takeaway: Due to the estimated scale of paper mill contributions, automated tools are necessary for their identification. More resources are required to support the development, testing and application of automated tools.

We have used automation to screen publications for wrongly identified nucleotide sequences, or incorrect gene sequences (2). Nucleotide sequences are used in experiments that study genes from humans and other organisms. They are like barcodes, in that they convey a meaning that cannot be read by humans, but can be verified by an appropriate detector. Incorrect nucleotide sequences can signal possible research fraud where their verified identities could not have produced the results that papers describe.

The Seek & Blastn tool created by Dr Cyril Labbé in Grenoble, France, uses an automated system of detection. Our experience with this tool over the past 5 years is that it provides scale that cannot be matched by human experts (2). Other automated tools are available to detect different questionable features of publications. However, the lack of research investments in error detection and correction mean that many automated tools, including Seek & Blastn, have not been developed or applied to their full potential. The results of automated tools also need to be checked by human experts, who require salary support that is difficult to obtain through research grants. Research on publication error detection needs to recognise the need for human experts and to provide training and career pathways that lead to rewarding careers in the field of error detection.

At least some paper mills are likely to use automation to produce research manuscripts at scale. Just as freely accessible tools such as Seek & Blastn can help researchers to identify unreliable research results, these tools could also be used by paper mills to produce more plausible manuscripts. The capacity to artificially generate highly plausible versions of experimental results could render paper mill manuscripts more difficult to detect. These developments *highlight the urgent need to deter paper mill submissions by targeting specific requirements of the paper mill business model,* as opposed to manuscript features that may not apply to all disciplines. This will be discussed further below.

How publishers and authors have addressed, or failed to address, the detection of research misconduct in their articles

Key takeaway: There are currently few incentives for publishers to correct problematic research, or for other scientists to report it. We urgently need to increase capacity to achieve timely corrections to the published record.

Major publishers and journals are now focussing on detecting manuscripts from paper mills and attempting to deter future submissions (1). However, variable screening approaches across different journals and publishers can mean that previously rejected manuscripts from paper mills can be accepted elsewhere. *Uniform screening practices and universal requirements to post all research manuscripts to preprint servers at the time of submission could reduce submissions from paper mills*.

Some publishers and journals have also implemented new manuscript standards that are intended to deter paper mill submissions. However, some suggested improvements can be very easily accommodated by paper mills and may not serve as useful deterrents. *More aggressive steps are required that will specifically disrupt the paper mill business model.* One such approach would be to delay manuscript submissions through a compulsory registration process at least one year prior to manuscript submission. This requirement could be designed to be compatible with the timeframes of genuine research, while seriously disadvantaging the rapid publication timeframes that are likely to be valued by paper mills.

While many publishers are now screening for paper mill features in manuscripts, few journals appear to be applying the same screening methodologies to their published archives. *Tools that can be used to screen manuscripts for features associated with paper mills should also be applied to published articles.* There are currently few incentives for journals to proactively screen their archives for erroneous publications and to then instigate retractions. Incorporating measures of post-publication correction into metrics such as the journal impact factor could incentivise post-publication corrections and tangibly reward proactive journals and publishers.

I can speak my experiences in bringing gene research publications with errors to the attention of journals and publishers. While a small number of journals have been highly supportive, many other journals appear to ignore error descriptions and requests for publications to be investigated. These experiences have been described by other teams, and collectively discourage error reporting.

The Committee on Publication Ethics (COPE) has recently described the need for retraction processes to adapt to publications from paper mills (1). We have proposed that journals could rapidly flag papers with verifiable errors (such as wrongly identified gene sequences) using neutrally worded notices before journal investigations start. These notices could be published very quickly in response to error notifications and could be transferred between different platforms, including PubPeer. A more rapid and responsive post-publication correction system would also encourage more researchers to recognise and report errors within the literature.

Summary

Paper mills represent an unprecedent challenge to scientific and academic publishing, but also provide an opportunity to enact transformational change. This can be achieved by increasing the oversight of scientific publishing, recalibrating our capacity to correct

published information, and changing the reward systems that underpin the careers of researchers and other professionals who publish within the academic literature. We must now commit to building and empowering the human and infrastructure capabilities that will be required to repair and safeguard our scientific literature for future generations.

References

(1) COPE. and STM. (2022) Paper Mills - research report from COPE & STM - English. https://doi.org/10.24318/jtbG8IHL.

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Professor Jennifer Byrne
Career summary

- BSc (Hons 1, University Medal) (1988) PhD (1993), University of Queensland, Australia
- NHMRC CJ Martin Postdoctoral Fellow (1993-1997) (France, Australia)
- Group Leader (1998-2019), Deputy Unit Head (2004-2008), Unit Head (2009-2019), Children's Cancer Research Unit, The Children's Hospital at Westmead, Australia
- Deputy Director, Kids Cancer Alliance Translational Cancer Research Centre (2018-2019), Australia
- Conjoint Senior Lecturer (2003-2006), Conjoint Associate Professor (2007-2016), Academic Leader (2017-2019), Conjoint Professor (since 2017), The University of Sydney, Australia
- Director of Biobanking (since 2019), NSW Health Pathology, Australia

Contributions to field of research: Byrne first reported the existence of incorrectly identified nucleotide sequence reagents within pre-clinical cancer research publications. She recognised that nucleotide sequence reagents represent a class of verifiable reagent that are prone to acquiring errors. These insights, combined with the descriptions of nucleotide sequence reagents in hundreds of thousands of research publications, underpinned the creation of the first semi-automated tool Seek & Blastn to fact-check the published identities of nucleotide sequence reagents. This fact-checking capacity had been present in the biomedical literature for decades but had not been previously recognised or leveraged. Byrne has leveraged features of papers with wrongly identified sequences that they have discovered to inform international debate on the possibility of systematic research fraud within the pre-clinical research literature, and to advocate for improved post-publication error reporting and correction. Seek & Blastn is now used to screen manuscripts at multiple biomedical journals as well as COVID-19 preprints through the international ScreenIT Group.

International and national profile: Byrne is known for her research towards understanding human gene functions, cancer genetics, cancer predisposition in children, improving biobank operations and support of biomedical and health research, and error detection and correction within the biomedical literature. Byrne was included as one of Nature's 10 people who mattered in 2017 for her error detection research, which has also been highlighted by Nature News (2017, 2020, 2021 (twice)), Retraction Watch (2017 (twice), 2018, 2019, 2021), The Atlantic (2018), Undark Magazine (2018), Wall Street Journal (2020), The Scientist (2021), and Times Higher Education (2021). She wrote about the need for clearer scientific communication in The Conversation in 2018. Recent international speaking invitations include as a keynote speaker and panellist at the CRI-CONF Computational Research Integrity Conference (2021), and as an invited/ keynote speaker at the Singapore Research Ethics conference (2021), the Science Integrity Symposium in Germany (2022) and the Science Studies Colloquium, Denmark (2022). Byrne chaired the paper mill symposium at the 2022 World Conference on Research Integrity.

Research support: AUD$15.7 million in funding as a chief investigator in the last 5 years, including National Health and Medical Research Council Ideas Grant APP1184263 as CIA "Prevalence and impact of fraudulent cancer research publications targeting the functions of human genes", AUD$4M from the NSW Luminesce Alliance to support paediatric cancer predisposition screening (2019-2022), AUD$1M from Frontier Health Medical Research to support the development of phage therapy in Australia (2021-2022)

Supervision and mentoring: Principal supervisor: 2 postdoctoral fellows, 11 PhD students, 10 Masters and Honours students, one current PhD student. Deputy Postgraduate Co-ordinator (2006-2011), multiple awards from the University of Sydney for outstanding postgraduate student teaching and supervision (2003, 2005 (two awards), 2011). Byrne has mentored candidates applying for level E promotion at the University of Sydney since 2019.

Current professional involvement (selected)

- Member, Steering Committee, Brain Cancer Biobanking Australia, since 2014
- Member, Victoria Cancer Biobank Scientific Advisory Board, since 2019
- Chair, Scientific Advisory Group, NSW Health Statewide Biobank, since 2019
- Member, ScreenIT Group, since 2020
- Asia Pacific Research Integrity Network Meeting Program Planning Board, since 2020
- Member, Education and Training Committee, International Society for Biological and Environmental Repositories, since 2021
- Member, Australian Brain Cancer Mission Strategic Advisory Group, since 2022
- Board member, Association for Interdisciplinary Meta-research & Open Science, since 2022

Journal editorial boards

- Subject Editor, International Journal of Biological Markers, since 2014
- Editor-in-Chief, Biomarker Insights (2019-2021)

Most relevant publications (from most recent)

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4. Weissgerber, T., Riedel, N., Kilicoglu, H., Labbé, C., Eckmann, P., ter Riet, G., **Byrne, J.**, Cabanac, G., Capes-Davis, A., Favier, B., Saladi, S., Grabitz, P., Bannach-Brown, A., Schulz, R., McCann, S., Bernard, R., Bandrowski, A. (2021). Automated screening of COVID-19 preprints: Can we help authors to improve transparency & reproducibility? Nature Med. **27:** 6-7.
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9. **Byrne, J**. (2019). We need to talk about systematic fraud. Nature. **566**: 9-10.
10. **Byrne J.A.**, Grima N, Capes-Davis A, Labbé C (2019). The possibility of systematic research fraud targeting under-studied human genes: causes, consequences and potential solutions. Biomarker Insights. **14:** 1-12.
11. **Byrne, J.A.,** Labbé, C. (2017). Striking similarities between publications from China describing single gene knockdown experiments in human cancer cell lines. Scientometrics. **110**: 1471-93.
12. **Byrne J.A.** (2016). Improving the peer review of narrative literature reviews. Res Integrity Peer Rev. **1**: 12.