Policy and legislation challenges for Open Science: Developments in Australia

Roxanne Missingham*
* *Chief Scholarly Information Officer, Australian National University, Australia*

Abstract. This paper investigates the current state of Open Science policies in Australia, focusing on the governance of research data, specifically addressing the processing of personal data for scientific research purposes. The purpose is to understand what challenges currently remain in order to best develop the governance of scientific research in light of Open Science principles. To do so, the study starts from the early phases of the development of Open Science, represented by the Open Access movement to scientific publications, up to the analysis of the Australian Data Availability and Transparency Act of 2022, proposing also a commentary on the proposed reforms regarding (i) privacy legislation; (ii) the issue of retention of research data; offering also (iii) a hint at the issue of copyright in relation to research data. From a methodological perspective, the paper is developed from direct engagement in the implementation of Australian Open Science policies and aims to provide an overview of the current situation.

Keywords: Open science, Research data, research publishing, privacy, data protection, ethics, retention

1. Open science: evolution and perspectives

Open science has been recognized as a movement whose goal to enable access to all aspects of international research over the past two decades. Across the globe scholars, librarians, and policy makers[1] have contributed to discussions based on a concept of delivering benefits to research, the public and institutions with a particular emphasis on overcoming the barriers faced by the "global south"[2].

While there are different views on the establishment of the open science, the first policy incursions were through the open access move-

[1] The structuring of benefits has been articulated in terms of educational, social, research, career and national benefits articulated in terms of the needs of stakeholders. Detailed analysis of benefits has been widely discussed, for example in Alemnehm, 2022 international and national benefits are articulated, Chan, Kirsop, and Arunachalam, 2011 focus on benefits to researchers and research with Kingsley, 2016 describing institutional and national benefits.)

[2] The "global south" is a term used to describe countries that are economically underdeveloped or disadvantaged - Latin America, Africa, Asia and Oceania. These countries are primarily located in the southern hemisphere. The knowledge disadvantage in terms of access and publishing and potential of open science beyond open access is described in Irfanullah 2021.

ment[3] seeking the opening up of access to scientific research through making works available on platforms to all users without charges for access. The pivotal point is acknowledged to have occurred in 2002 and 2003 period.

> OA was defined in three influential public statements: the Budapest Open Access Initiative (February 2002), the Bethesda Statement on Open Access Publishing (June 2003), and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (Suber, 2019).[4]

The international statements were notable as they represented the views of researchers, funders, librarians and policy makers. Over 6700 individuals and 1520 organization signed the Budapest Open Access Initiative. The meetings included researchers from a wide range of disciplines – from physics to historians, anthropologists the medical specialists. The expressions of a need for a new policy environment with solutions that supported the broadest availability of knowledge was a rallying call that resulted in international debates with a wide range of policy and practice changes.

At its heart this first step in open science was seeking universal access to knowledge. In its formation period, the Open Access movement advocates focused on access to journal articles published in scientific journals. Researchers were optimistic that change would be speedy and comprehensive. Early advocate Stevan Harnard proposed OA as a "subversive" change that should be contagious.

> First in 1994, when I made the subversive proposal; I thought it would just take a year or two and the transition to universal self-archiving would be complete. (Harnard, quoted in Natuka, 2015).

Library advocacy was stimulated in no small way from the significant increases in costs of subscriptions. The arguments in favour of open access were that financial pressures were reducing access to journals for university employees due to price increases. Specific benefits for

[3] Key foundation steps can be found in Peter Suber's analysis of the history open access (Suber, 2009) including initiatives established prior to 1990 such as Project Guttenberg and The Text Encoding Initiative. The open-access.network's analysis, open- access.network 2023, commences their timeline with Paul Ginsparg's foundation of arXiv archive of preprints for physics preprints at Los Alamos National Laboratory.

[4] The statements can be found online - Budapest Open Access Initiative, February 14, 2002 https://www.budapestopenaccessinitiative.org/read/, Bethesda Statement on Open Access Publishing, June 20, 2003 https://dash.harvard.edu/handle/1/4725199 and Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, October 22, 2003 http://oa.mpg.de/lang/en-uk/berlin-prozess/berliner-erklarung.

institutional impact also formed part of the arguments for this first foray into open science. The history of these arguments is summarized in Jurgen 2020.

Advocates have proposed benefits of open access to specific communities. Librarians in seeking affordable solutions have emphasized new models of purchasing to achieve wider societal benefits focused on benefits to researchers that would have implications for their careers[5]. Researchers' advocacy has focused on benefits to the careers of individuals[6] together with a dimension of public benefit from disseminating research to those outside of academia who could directly benefit[7].

These perspectives have led to toolkits and debates that centered on the need for new business models that would pay for open access. Publishers introduced article payment charges and policy makers looked at interventions that could speedily introduced open access. The UK's Working Group on Expanding Access to Published Research Findings chaired by Dame Janet Finch recommended funding be allocated to increase open access with £10 million invested by the Government in 2012 to help universities with the transition to open access. While analysis has shown the significant investment did increase open access, it has been criticized for a lack of fundamental reform to the scholarly publishing process (see Clare 2018).

The nature of the discussion on benefits and the UK intervention are significant as they frame the agenda for change as economic and technical publishing processes. Debate on legal matters such as copyright legislation and research data ethics, took a poor second place in analysis for reports to achieve open access.

Recently "Open science" has emerged as the broader practice of making all forms of research openly accessible. UNESCO (UNESCO, 2023) and the OECD (OECD, 2023) have initiated major programs. With the rise of open access practices to research data, methodology and citizen participation in science (so-called citizen science), the initial approach, focused on publications, has become only part of the issue. In fact, now, the central theme has become a rethinking of the workings of scientific research also in terms of the accountability of research and

[5] For example guidance focused on researchers has been produced by national organisations such as JISC in the UK (JISC, 2019) and Open Access Australasia in Australia (Open Access Australasia, 2021)

[6] For example, McKiernan et al analysis of the importance of citations and open access for careers of researchers

[7] The statement from the Office of Science and Technology Policy (United States. Office of Science and Technology Policy 2023) announcing guidance for agencies to update their public access policies and the statement in Australia of the Chief Scientists (Foley, 2021) emphasised the policy changes required at a national level to achieve science as a public good through open access as a tool for open science.

institutions, as well as archiving and access, while ensuring legal certainty. Leading discussions at this level are significant as they influence national policies around the globe.

The new generation of reforms for open access through the concept of Open science has provided the opportunity to highlight a range of legal issues not previously analyzed.

This paper explores the Australian approach to open science, focusing on research data, drawing the attention on the actions required in relation to ethics, copyright, privacy and data sharing legislation. The recent work of the Australian Research Data Commons on a research data management framework highlights how legal issues can be addressed within current legislation. Reviews of the Privacy Act 1988, Australian Research Council Act 2001 and Copyright Act 1968 together with the approach to Commonwealth Government data under the Data Availability and Transparency Act 2022 indicate that a profound change is taking place. Against this backdrop this paper investigates how and to what extent a research data management model needs to be developed.

2. The evolution of the Open Science approach in Australia

Initially, two major policy initiatives set the path for open access to publications as the first step of open science in Australia. The first was the federally funded Australian Partnership for Sustainable Repositories project. It focused on implementation of an open-source software solution for institutional repositories able to give open access to a broad spectrum of digital objects relevant to the research process. In launching the funding for the initiative, the acting Minister for Education, Science and Training stated:

> APSR has three parts. First, the proposal has an overall focus on the critical issues of the access continuity and the sustainability of digital collections. Second, it will build on a base of demonstrators for digital continuity and sustainability, embedded in developmental repository facilities within partner institutions. Third, it will contribute to national strength in this area by encouraging the development of skills and expertise and providing coordination throughout [sic] the sector. APSR will actively provide international linkages and national services (McGauran, 2003).

Additional programs funded by the government included the Australian Research Repositories Online to the World, a discovery services delivered by the National Library of Australia, and the Regional Uni-

versities Building Research Infrastructure Collaboratively, which expanded the repositories to regional institutions. The diverse projects led to increased awareness of the importance of "open" and the complexity of infrastructure requirements[8].

The second major initiative was the establishment of an open access incentive policy. The two major commonwealth institutions funding research are the National Health and Medical Research Council (NHMRC) and Australian Research Council (ARC). In 2012 the NHMRC launched its Open Access Policy covering journal articles. In 2013 the ARC's Open Access Policy was implemented covering a broad range of published outputs. This had an immediate effect on changing the behavior of university researchers. In 2022 the NHMRC updated its policy to require immediate open access.

Starting from these initiatives, Australian universities have adopted open access policies with a range of requirements[9].

The breadth of initiatives moving nation policy and practice towards open science has been documented by Open Access Australasia.

Figure 1. Connecting the dots. Compiled by Open Access Australasia (Open Access Australasia, 2021)

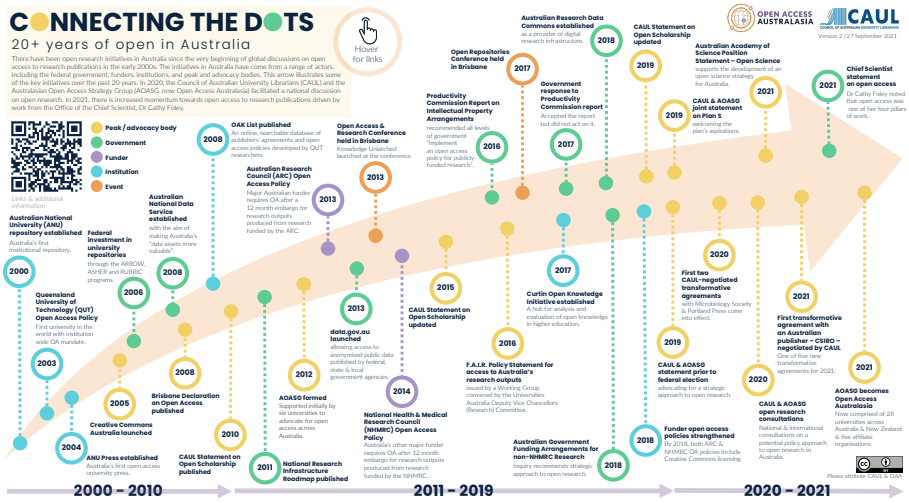
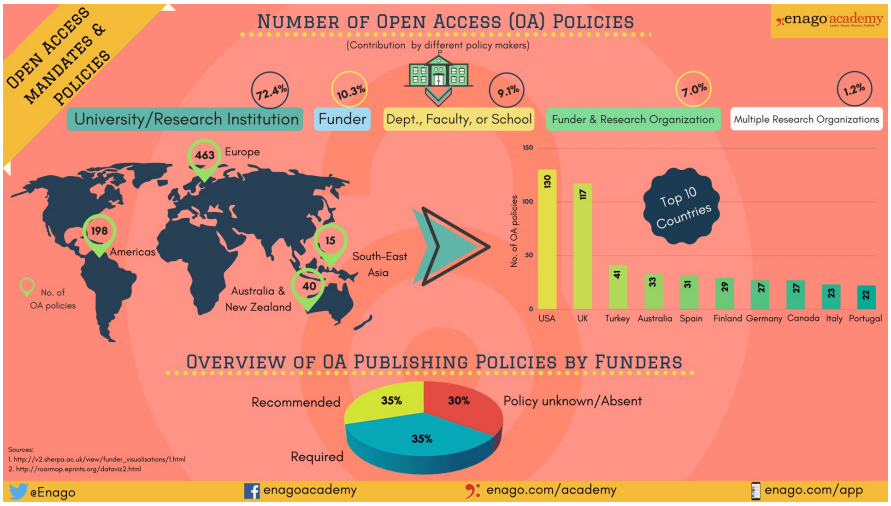


Figure 2. International open access funder policies (Enago Academy, 2018)

[8] Analysis of the deeper issues can be found in Henty and Burton 2008 and Henty 2007.

[9] There are significant variations in the policy approaches taken by universities leading to different programs to initiative open access and open science (see Wakeling et al 2022)



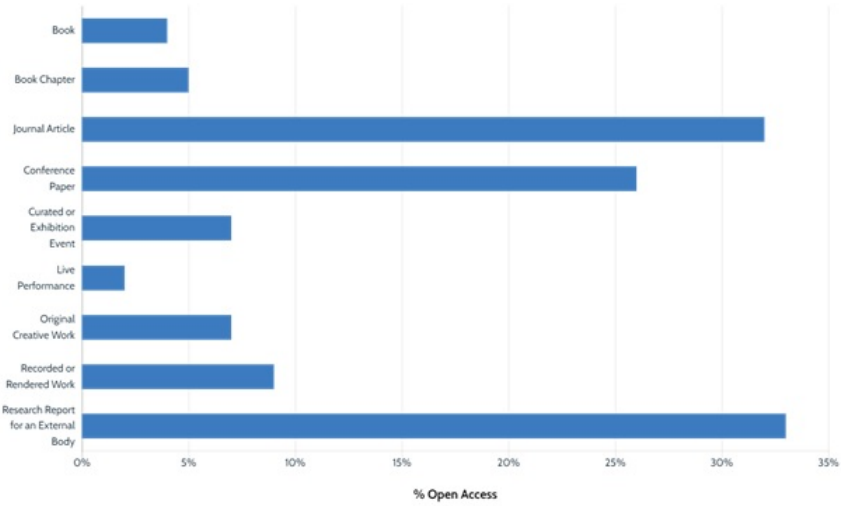
The move to adoption of policies by funders echoed an international trend, as described in Figure 2. Overall, the early steps focused on building infrastructure and creating change through policy initiatives. Reform through regulation was achieved by guidelines developed by funders. Consider, in addition, that the need for legislative reform was not articulated in the program of actions for open science.

2.1. Lessons for Open Science from the approach to open access

The initiatives gave national visibility to the importance of open access, representing the open science approach as a fruitful way to address change in the research sector. The analysis of the early stage is important to understand how the next stage of open science initiatives built on the successes and failures of the open access program.

With mandates from the national funders for publications from funded research, policy makers achieved some change in access to the research outputs. A national assessment of Australia's research has been undertaken over the past decade by the Australian Research Council (ARC, hereinafter) for the Commonwealth Government. The evaluation, entitled Excellence in Research for Australia (ERA), "identifies and promotes excellence across the full range of research in Australia's higher education institutions" (ARC, 2023). The 2018 assessment included analysis of the degree to which research published in the past five years was openly accessible. This measure of policy impact showed that existing policy interventions had produced smaller results that those advocating for open access had sought, as described in Figure 3.

Figure 3. Percentage of open access research outputs in ERA 2018 submissions. (ARC, 2018).



From the analysis of the first open access policies, there are three lessons learnt, to be kept in mind in the next phases of open science policy development and implementation.

- The combined advocacy of different actors - researchers, librarians, institutions and policy makers - was essential to enable systematic reforms at a national level. The actors engaged both with each other and with government to provide compelling arguments aligned to national benefit to establish reforms that led to greater open access. This formed an alignment that could very effectively support the next steps in policy advocacy.

- Initiatives led through policy intervention from funders significantly increased the number of articles made openly accessible. Establishing infrastructure and education programs had created a slow start to open science through open access. While the ARC figures indicated that the majority of research outputs remained behind paywalls, the increase after funder mandates was significant compared to the previous period. This is demonstrated in the CAUL statistics on content in repositories (Council of Australian University Librarians, 2022).

- Overall progress was limited with the majority of research outputs remaining between paywalls. A guidance and policy-based

approach that did not include legislative reform resulted in only part of the scholarly communications system changing to deliver open science to the world.

Starting with these three lessons, the next section focuses on data management and openness as part of the Open Science approach.

2.2. Open data: open science moves on

In Australia discussion on open data was a topic for significant advocacy after the launch of the Findability, Accessibility, Interoperability, and Reusability (FAIR) principles, developed by the international research community to:

- support knowledge discovery and innovation both by humans and machines;
- support data and knowledge integration;
- support new discoveries through the harvest and analysis of multiple datasets and outputs;
- promote sharing and reuse of data;
- be applied across multiple disciplines, even those that involve sensitive data;
- help data and metadata to be 'machine readable'. (Wilkinson 2016)

The Council for Australian University Librarians together with Open Access Australasia created a working group of policy players to increase awareness of and engagement in policy debate. The Australian Research Data Commons, a federally funded program, developed advice and support material (Australian Research Data Commons, 2022). Advocacy was the primary focus with connections to commonwealth government agencies a priority.

2.2.1. *Institutional Underpinnings Program*

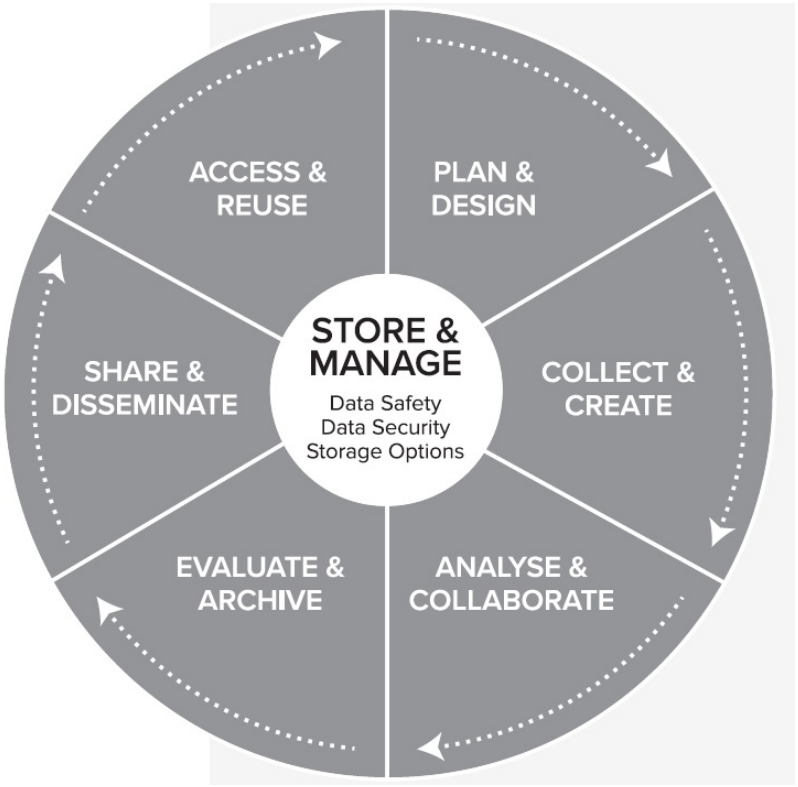
Over the past two years the Australian Research Data Commons has led a major project into research data management to establish an understanding of the issues and develop a framework for better data management, promoting the openness of research data (see Figure 4). Twenty-five Australian universities actively participated in the project through an editorial committee and expert working groups.

The framework is intended to inform institutions' design of policy, procedures, infrastructures, and services, improving coordination

of research data management within and between institutions. The effectiveness of the guidance was tested in local projects.

The final report, launched in February 2023 outlines nineteen elements essential for research data management in Australian universities. Nine elements are opportunities for immediate collaborative action.

Figure 4. The lifecycle of Research Data (Australian Research Data 2023 p. 9)



Legal issues relating to open access of data primarily fall into the follow components:

– Element 3: Principles defined by local institutions. Policy lays out the principles that govern the institution's approach to research data management. The relevant legal matters include ethics, privacy, copyright, intellectual property, and research agreements, particularly with funders.

– Element 5: Research Data Retention and Disposal. Institutions are responsible for large quantities of research data and also for

retaining this data to meet their regulatory requirements. The Commonwealth, States and Territories have Archive legislation that are implemented through record retention agreements including research data. Funder agreements and approvals from ethics committees will also frequently include retention periods. Participant consent requirements need to be outlined for individual research projects that must be managed and mapped into Data management plans.

– Element 6: Open Research and Data Publication. This element is based on identification of benefits of open access including research integrity, reproducibility, collaboration, and innovation. Research funders are increasingly requiring that research data be made open. By enabling open research and data publication, institutions help researchers to meet these requirements.

– Element 7: Sensitive Research Data. Compliance with Privacy legislation and ethics conditions is required to ensure that data that contains sensitive information is not disclosed or mishandled. Special protections are required when managing sensitive research.

Case studies have articulated model guidance that is specific to individual universities [10]. The differences in requirements for universities are due to the different legislation that is relevant in each state, territory and federally. The major areas of legislation relevant to managing data and making data openly accessible are under review at the different levels of government. In the following, the analysis addresses three central issues: (i) privacy legislation and the management of personal data in scientific research; (ii) the issue of data retention; and finally (iii) a hint at the issue of copyright in relation to research data.

2.2.2. *Privacy legislation*

Compliance with legislative requirements in relation to privacy has been a key element in ethical decisions for research data collected about individuals. Australian legislation has been in place for two decades with regular review and revision. Privacy is a key element in the open science landscape. The data collected for research purposes may represent significant personal information. Consider, for example, surveys

[10] The case studies can be found here https://ardc.edu.au/multi_project/australias-research-data-management-framework and include: Research Data Management Policy and Guidelines, Implementation and Enablement of FAIR and CARE Principled Research Practice at UniSQ with a Focus on Research Data Management Planning and Active Data Management and Open Research, Data Sharing and Opportunities in Ethics Processes.

collecting data for social science or health and medical research. The principles of data minimization and protection of sensitive data have been established in codes of conduct for researchers. Legislation had been developed in Australia at commonwealth, state and territory level, focusing on data used for commercial and government purposes rather than consideration of research needs.

The increase in data breaches and the community concerns about data has led to a focus on protecting rather than sharing data. The consequence has been the establishment of an approach that requires clear consent for all use and data management able to ensure protection of personal data. For researchers the focus has been on protecting rather than sharing data because of the culture around privacy reflected in legislation. Although the protection of individuals' personal data is fundamental, it is also important not to harm or impoverish future research.

Balancing the factors of sensitivity of data while being able to share data, particularly in an anonymized or deidentified manner, is crucial for improvements in research data management practices.

The Australian Attorney-General's Department has recently conducted a review of the Privacy Act. The Privacy Act Review Report 2023 (Attorney-General's Department, 2023a) was released in late February. The review of the Privacy Act 2020 commenced following recommendations by the Australian Competition and Consumer Commission in its 2019 Digital platforms inquiry final report. The Act was amended in November 2022 through the passing of the Privacy Legislation Amendment (Enforcement and Other Measures) Bill 2022 which addressed urgent matters for legislative reform increasing penalties, the powers of the Office of the Australian Information Commissioner (OAIC) and the Australian Communications and Media Authority.

On 16 February 2023, the Attorney-General publicly released the Privacy Act Review Report. Section 14 of the report addresses research and privacy, which was raised by stakeholders during initial consultation. The Act provides that the collection, use and disclosure of personal information and sensitive information by agencies and organizations to conduct research can occur in certain circumstances without the need to obtain individuals' consent. This recognizes the public interest in human-based research. While the Discussion Paper did not specifically address the research exceptions under the Act, submitters raised concerns about the impact of various proposals canvassed in the Discussion Paper on research. Some stakeholders also suggested the specific research exceptions should be revisited in light of these proposals.

A summary of the research provisions of the report is presented below.

> Proposal 14.1
> Broad consent for research Introduce a legislative provision that permits broad consent for the purposes of research: (a) Broad consent should be available for all research to which the research exceptions in the Act (and proposed by this chapter) will also apply. (b) Broad consent would be given for 'research areas' where it is not practicable to fully identify the purposes of collection, use or disclosure of personal or sensitive information at the point when consent is being obtained.
>
> Proposal 14.2
> Consult further on broadening the scope of research permitted without consent for both agencies and organisations.
>
> Proposal 14.3
> Consult further on developing a single exception for research without consent and a single set of guidelines, including considering the most appropriate body to develop the guidelines. (Attorney-General's Department, 2023, p. 9-10)

In the international legislation, consent still plays an important role in the processing of personal data for scientific research purposes. On this aspect, the European legislation on data protection, represented by the General Data Protection Regulation (GDPR, hereinafter), states:

> It is often not possible to fully identify the purpose of personal data processing for scientific research purposes at the time of data collection. Therefore, data subjects should be allowed to give their consent to certain areas of scientific research when in keeping with recognised ethical standards for scientific research. Data subjects should have the opportunity to give their consent only to certain areas of research or parts of research projects to the extent allowed by the intended purpose. (European Union, 2016)

Adopting an approach that recognises an exception to individual consent to allow the processing of personal data for research purposes as a public interest would provide an effective means to address complex issues in current practice. Future research needs are not known at the time consent is sought and unforeseen issues may arise that could not be covered by the original consents.

The Australian Institute of Health and Welfare highlighted recommendation 65-2 to amend the Privacy Act to 'extend the arrangements relating to the collection, use or disclosure of personal information without consent in the area of health and medical research to cover the

collection, use or disclosure of personal information without consent in human research more generally'.

Guidelines under section 95A of the Act[11] take an expansive view of 'public health or public safety'. The Office of the Australian Information Commissioner takes a narrower approach in its Guide to Health Privacy, The Australian Law Reform Commission (ALRC) report suggested that there was 'no in-principle reason' to limit the scope to health and medical research". The ALRC also noted the comparative broadness of the research exceptions in other jurisdictions, such as the UK, Canada, and New Zealand.

The third recommendation is based on the ALRC's recommendation to combine the research exceptions and guidelines under sections 95 and 95A to create a single set of legally binding rules for research applicable to both organizations and agencies. A single set of research rules could be developed and issued by the Privacy Commissioner rather than the NHMRC to cover all types of research.

National debate is well focused on the limitations of the current privacy legislation on research that will benefit citizens and future research – the public good element. The proposed changes for the Commonwealth Privacy Act have the potential to systematically increase open science. Currently the government is consulting with the community thus legislative change is some time away. Any changes would result in amendment to university policies for those covered by commonwealth legislation. State and territory legislation would like to be amended.

2.2.3. *Data retention*

The retention of data processed for research purposes deals with a complex set of legal provisions. Retention of records is described in Archive and record keeping legislation and agreed with national, state and territorial records authorities. These processes are well established with the record retention agreements focused on the retention of business records. Their application to research data is clear and not often reviewed.

The framework has been developed on business records. As a consequence, the sharing and the reuse of research was an overlooked factor in the definition of regulatory instruments agreed between authorities and universities. In order to implement the Open Science approach, effective processes are needed to preserve data beyond the normal retention period for administrative documents.

The legislation about health sector has taken into consideration future research use and can form a model to establish principles for re-

[11] For example https://www.nhmrc.gov.au/about-us/publications/guidelines-approved-under-section-95a-privacy-act-1988.

views of data retention agreements with archive and record authorities.

> Clinical trials (drug and device trials) are governed by the Therapeutic Goods Administration. Section R6E2 of the Guideline for good clinical practice36 requires full and verifiable capture of data and decades-long retention of data for investigational medicinal products. Likewise, ISO 14155: 201137 requires the same level of record-keeping and long-term data retention for investigational medical devices. (Australian Research Data Commons, 2023, p. 18)

For the scientific community perspective, the landscape is made even more complex because of the need for data management planning before research is undertaken. This planning is required for ethics approvals that need to be obtained from their institutional ethics committees. Funders may also include in agreements requirements around retention which will be reviewed in terms of the university's risk assessment.

A lack of clarity from the different types of legislation for record keeping, the codes of conduct and ethics processes within institutions and the complexity of funder and discipline codes of practice may represent impediments to the Open Science The report on the Privacy Act raises this issue. The review into the Australian Research Council Act 2001 (Sheil, Dodds and Hutchinson, 2023, p. 18) suggests that actions on open science should take these impediments into account.

Privacy and cybersecurity by design are well-established principles and useful tools. Converging measures of privacy, data protection and cybersecurity by design with the development of Open Science practices may require a rethinking of Australian legislation, in line with what happened with GDPR in the European Union.

2.2.4. *Intellectual property and copyright*

Australia's copyright regime is based on a fair dealing approach1, as opposed to the fair use principles adopted in other countries such as the United States. The complexity of the exception-based approach means that researchers (and those supporting them) need to navigate a maze of complex legislative provisions. This adds significant complexity to considerations about steps to advance open science. As with other policy areas, there are a range of actors with the additional interest of funders and institutions in commercialization of research.

The topic of data ownership is very challenging and generates unprecedented problems. Therefore, the legislative framework is currently undergoing a reform process. Balancing various and different interests require the adoption of an inclusive process, as legislative reform will not be possible unless there is clarity and agreement about the benefits to be achieved.

The complexity of different views of actors is increased by differing levels of awareness of the opportunities from achieve an open science approach to innovation (for example Lacey, Coates and Herington, 2020 found different levels of knowledge by researchers and scientists). Achieving changes in practice requires a renewed debate on how making data openly available can support innovation in multiple ways.

There are two particular aspects of copyright that limit open science Australia. The first is the limitation on use of quotations. Under current legislation to use quotations from others requires permission. Participants can also withdraw consent at any time resulting in complexities in data management and release of data and publications from research studies. Researchers have limited knowledge about this complex area in copyright, in particular those who have worked in countries where fair use legislation has been adopted.

The second area of concern is that the legislation contains provisions that limit using data previously collected. Generally, consent is collected for a particular use, such as an individual research project. The copyright in this material expires 70 years after the death of the person who provided the data, with records of contact information for individual affected by changing conditions such as death, changing address and employment. Data cannot current be reused easily without individual permission. Changes to allow for clear guidance for use of material under "orphan works" provisions would significantly improve the opportunity to make deidentified or anonymized data available for reuse and for open science. At present the Australian legislation has no orphan work provision that would enable a researcher to undertake diligent research and, when the copyright owner cannot be found.

Quotations and orphan works have been raised in consultations and debates over copyright reform by the university and library sectors over the past decade. Submissions to the reviews of the Copyright enforcement review 2022-23 (Attorney-General's Department, 2023b) by Universities of Australia and the Council of Australian University Librarians highlight the importance of addressing the issues in the current round of copyright legislative review. The issues are two of the five high priority issues agreed by the Attorney General at the Ministerial Roundtable meeting (Attorney General, 2023).

An important element of the discussion on copyright reform is its compliance with the Berne Convention (World Intellectual Property Organization, 1979). Article 10 of the convention recommends a principle that would assist the implementation of open science, stating that:

> "It shall be permissible to make quotations from a work which has already been lawfully made available to the public, provided that

their making is compatible with fair practice, and their extent does not exceed that justified by the purpose, including quotations from newspaper articles and periodicals in the form of press summaries".

Revising the Copyright Act would remove a significant barrier to open science in terms of reusing and sharing data, and publishing both data and scientific papers, appropriately deanonymised and de-identified. Addressing these hurdles, in a manner that adequately tackles privacy, data security and ethical issues, would move Australia towards a more effective implementation of open science.

3. Australian governance of research data: A model approach

Over the past 4 years the commonwealth government has developed a new framework and legislation for making data available for research. Extensive consultation was undertaken with government agencies and data users. Led by the Department of Prime Minister and Cabinet, the work has resulted in a legislation, the Data Availability and Transparency Act 2022, that creates a scheme that provides controlled access to data to trusted people and organizations.

An independent regulator, the National Data Commissioner, oversees the scheme and aiming to hold all participants accountable to a robust standard of security and transparency.

Data covered by the scheme includes all data lawfully collected, created, or held by a Commonwealth body, or on its behalf[12].

The scheme is significant as it sets a standard for opening up data through controlled mechanisms. The principles set in the legislation can be assessed in term of impact on future research and community benefit. Issues such as metadata, retention and data sharing practices can be established within this controlled environment. The work of the National Data Commissioner can influence future legislative changes that can impact all research entities.

A significant benefit of the approach to the Australian governance of research data as through legislative reform is that the change in terms of greater access to data, delivering open science goals, is uniformly progressed.

[12] Content ranges from data on the weather, personal and business data, through to freight and traffic movements, and agricultural yields. Details can be found at https://www.datacommissioner.gov.au/sites/default/files/2023-04/Introducing%20th%20DATA%20Scheme%20-%20April%202023.pdf.

4. Conclusions

Open science has evolved over the past decade from the early discussions on open access to publications. Governments around the world are reviewing policy objectives and legislative issues in order to foster the openness of the scientific research process.

Australia is at a pivotal point in terms of identifying legislative change that would enhance open science. This sits within an increasing awareness of the potential of open science to benefit the community and research. The report of the review into legislation relating to Australia's major national government has stated "engagement with current and ongoing debate around the shift towards open access, open data and open science" (Sheil, Dodds and Hutchinson, 2023. p. 18).

Identifying the need for national reform does not exist within a vacuum. Internationally developments such as the announcement of the White House Office of Science and Technology Policy (United States Office of Science and Technology Policy, 2023), outlining new actions to advance open and equitable research, indicate the issues that need to be addressed now. Aligning grant funding, research infrastructures, research participation for emerging scholars, and expanded opportunities for public engagement is required to make a significant step forward in open science. Publishers and institutions are ready to establish new guidance, support and systems.

In Australia, the recognition of the importance of open science, including access to publications and data, is high in policy reports as well as reviews of legislation. The Productivity Commission, the governments national economic and social advisory body, has emphasized this in a recent report:

> Recommendation 5.3 Improving collaborative networks and knowledge transfer Governments could strengthen collaborativenetworks for diffusion and facilitate knowledge transfer through:
>
> - requiring open access for government funded research in journals, papers and publications that is currently locked behind paywalls. In implementing this change, the government should compare the benefits and costs of the Chief Scientist's proposed open access model with the benefits and costs of other potential approaches (...).
>
> Recommendation 5.13 No-cost or low-cost access to ideas that have large public good value. To support the diffusion of best practice and knowledge that has already been generated by innovative businesses, not-for-profits and government organisations, the Australian Government should:

> - require open access to research principally funded by governments (see recommendation 5.3 of this report for further detail)
>
> - reform fair use provisions in intellectual property regulations to adopt a principles-based fair use exception. (Productivity Commission, 2023, p. 90-1).

The Australian Chief Scientist has also actively advocated for open access for publications as a first step towards open science (Foley, 2021).

The practices on sharing and reuse of research data are achieving greater attention also by local institutions (i.e., universities and research centers).

However, scholars recently have expressed some concerns with the lack of speed in achieving open science.

> The world of scholarly publishing is heading into its fourth decade of open access experiments and innovations (. . .) with the current rate of growth suggesting that universal open access to research is still decades away (Willinsky, 2022, p. 6).

Barriers to progress in open science, particularly for data, include copyright legislation (Caso and Dore 2022), privacy and intellectual property (European Commission Directorate-General for Research and Innovation, 2022) are widely identified as needing urgent attention. Despite being aware of these bottlenecks, the Australian approach lays the foundation for future developments and the promotion of a scientific research process that is as open as possible, in line with the human right to science, as enshrined in Article 27 of the Universal Declaration of Human Rights (Paseri, 2022). In this regard, international organizations are actively engaging in the development of recommendations on science such as UNESCO and OECD. Their goals for the coming years are to turn those principled statements into actions in member countries. The linking of international pressure and development of greater knowledge from government initiatives, such as through Plan S[13], creates an environment that signals profound change on scholarly communication in the broadest of terms. This is an area that will generate significant change if the momentum is retained.

Overall, the experience of building infrastructure and guidance of open access has been a very important first step for open science

[13] Plan S is an initiative for Open Access publishing that was launched in September 2018. The plan is supported by cOAlition S, an international consortium of research funding and performing organisations. Plan S requires that, from 2021, scientific publications that result from research funded by public grants must be published in compliant Open Access journals or platforms. .For more information see https://www.coalition-s.org/.

in Australia. Creating a fully formed open science agenda requires more fundamental legislative reform through holistic measures, based on consultation and detailed analysis. Reviews of national legislation, economic and scientific policies suggest that there is still a long way to go, but the time is ripe to make open science practical and operational. Significant work will be needed in the coming years to maintain the efforts made so far and to promote open science as much as possible.

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