Going for gold: towards a gold standard Australasia open biomedical repository to help save lives

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Abstract:

This paper synthesises the findings from research on the conceptualisation of an Australasia open biomedical repository (OBR) from a Knowledge Management System (KMS) perspective (Kruesi, 2021b). Action research methodology was applied to investigate three research propositions. A KMS framework was developed that aligns the requirements for an OBR with the people, process, technology and content elements of an Australian KM standard. The framework identifies and defines nine processes underpinning biomedical knowledge–discovery, creation, representation, classification, storage, retrieval, dissemination, transfer and translation. The research problem, research design and methods and the research pathway set the scene prior to the discussion on the challenges of achieving an Australasia OBR. The implications of the research and the opportunities for future related research to establish gold standard, sustainable Australasia open access biomedical repository that helps to generate opportunities from research output to save lives are explored.

Keywords: open scholarship, open access, disciplinary repositories, knowledge management

Introduction

In late 2000, institutional repositories were set up in Australian universities to provide access to scholarly output published by their academic researchers (Steele, 2013). Around this time, the US PubMed Central (PMC) commenced as a disciplinary repository of full-text biomedical research articles, making the output from the National Institutes of Health's (NIH) research openly and permanently available (Roberts, 2001). A decade later international

biomedical PMC nodes in Europe and Canada were established. PubMed linked to PMC makes research evidence in the life sciences accessible throughout the world (Williamson & Minter, 2019). The Australasian region lacks a consolidated repository to make biomedical and health sciences research accessible, discoverable, interoperable and permanently findable.

The core of an Australasia OBR could be the US PubMed and PMC. There are various options available to populate an Australasia OBR. Harvesting citations from existing repositories and inviting Australasian researchers to deposit their research papers directly in an Australasia OBR are options for consideration. It would be necessary to have certain zones within the repository for content excluded from PMC. Removing the research content out of silos and locating it in discoverable zones could be achieved through the application of the KMS framework to design the OBR

Research Problem

The research problems included an inadequate system for researchers to comply with funders' open access requirements, fragmentation of institutional repository content, along with challenges of accessibility, discoverability, interoperability and permanency of biomedical research output in the Australasian region.

Three research propositions guided the action research. The first proposition investigated was that there is stakeholder interest in an investigation on the opportunity for an Australasia OBR, as a potential member of PubMed Central (PMC) International. The second proposition was that a KMS approach provides a sound basis for developing a conceptual framework for an OBR. The third proposition was that KMS provides an effective theoretical framework for analysing and evaluating designs for repositories and platforms that support the advancement of open scholarship.

Research Design and Methods

The three aforementioned research propositions are listed in Table 1., and aligned with their associated action research cycles. A variety of techniques were applied during my research, including interviews, case studies, focus groups and a workshop.

Table 1. Action research cycles and research propositions

Cycle Number	Cycle Theme	Research Proposition
One	A strengths, weaknesses, opportunities and threats (SWOT) analysis to assess the support for investigating membership of PMC International	There is stakeholder interest in an investigation on the opportunity for an Australasia open biomedical repository, as a potential member of PMC International.
Two	Conceptual framework of an Australasia open biomedical repository	A KMS approach provides a sound basis for developing a conceptual framework for an OBR.
Three	Use of the KMS framework to analyse and evaluate designs for open scholarship repositories	KMS provides an effective theoretical framework for analysing and evaluating designs for repositories and platforms that support the advancement of open scholarship.

In accordance with action research methodology, the planning stage of each research cycle included the detail on the research, the techniques utilised and the population engaged for the data collection (Kruesi, 2021b). Data analysis in each cycle involved both automated and manual effort. For example, in Cycle One, the verbatim data transcripts were imported into NVivo, coded, analysed, and reflected on, to create the final version of the SWOT analysis. NVivo was used to code the data transcripts into the final version of the SWOT analysis.

Each action research cycle was a continuous cycle of planning, collecting data, documenting and reflection. The action produced experience which at times changed the thinking related to the transition to the next cycle; an example was the decision to evaluate the KMS framework on different types of information systems in Cycle Three, following the development of the conceptual OBR in Cycle Two. Adherence to the requirements of Monash University Human Research Ethics policies was maintained throughout this research project

Research pathway

The findings for the first proposition, that '*There is stakeholder interest in an investigation on the opportunity for an Australasia open biomedical repository, as a potential member of PMC International*' are published in a major open scientific journal (Kruesi, Burstein & Tanner, 2019). The question on the opportunity for an Australasia OBR was discussed with a wide cross-section of 45 potential stakeholders. All of the stakeholders contacted during Cycle One were interested in an investigation into the opportunity for an Australasia OBR. It is important to note that a senior executive and a head biomedical researcher both expressed interest in a multi-disciplinary open repository more so than an open biomedical repository. Two of the clinicians indicated that repositories such as PMC are just for biomedical researchers because those working in clinical practice have such huge clinical loads and are usually full-time in the trenches (Marley, 2016). All of the other stakeholders signalled their resounding support for an investigation into the opportunity for an Australasia OBR.

The conceptual KMS framework that was developed is a comprehensive approach based on its design as a sustainable OBR incorporating the nine KM processes (discovery, creation, representation, classification, storage, retrieval, dissemination, transfer and translation), each aligned with the elements (*people, process, technology* and *content*). A detailed version of the KMS framework for an OBR was published in *the Journal of Knowledge Management* (Kruesi, Burstein & Tanner, 2020). An earlier version of the framework was introduced at national and international outlets (Kruesi, Burstein, Tanner & Todd, 2018; Kruesi, Tanner & Burstein, 2019; Kruesi, Tanner & Burstein, 2018).

The third proposition, that '*KMS provides an effective theoretical framework for analysing and evaluating designs for repositories and platforms that support the advancement of open scholarship',* is explored in detail. An analysis and evaluation of two repositories and two platforms (information systems) was undertaken to test the KMS framework. The analyses and evaluations of the four information systems using the KMS framework demonstrated the robust nature of the framework. With each of the evaluations it was possible to refine the approach by improving definitions of processes and the gradings. The addition of colour coding to the procedure was a beneficial feature. From the grading, it was possible to compile snap-shot summaries that provide at a glance a visual of the mix of positive and negative aspects of the information system. A collaboration with the Associate Professor from the University of Bucharest on the workshop held with the higher degree students provided feedback on the use of the KMS framework as an evaluation tool for repositories and platforms that support open scholarship. A lightning talk on Cycle Three was accepted for presentation at the virtual

Medical Library Association's Meeting held in May 2021 (Kruesi, 2021a) and a further research publication on this work is in progress.

The research based on action research methodology proved to be an effective approach to produce new knowledge about scholarly communications, whilst also addressing practical problems.

Discussion

Regional, national and state challenges

There are significant challenges and hurdles that exist in Australia to achieving national coordination of open science information systems. During the COVID-19 pandemic, the power and the abilities to influence healthcare matters by government at state and territory levels have been demonstrated, although less so on a national basis, as is evident from the slow vaccine roll-out and the failed quarantine system (Ferguson, 2021). For at least two decades, it has been highlighted that there is no coordinated, national policy for purchasing and providing access to digital health information and knowledge resources and services on a level that expands jurisdictional boundaries throughout Australia (Australian Library and Information Association, 2008). Most states do have networks providing access to health knowledge resources for health professionals and other employees in the public health sector. The library services within the university sector provide subscription and other research content for their students and staff. Gaps exist in health information content provision for medical research institutes and private practitioners in Australia. Evidence of the threats, such as a lack of a national body to make a long-term commitment to establish and fund an Australasia OBR, were identified in Cycle One of this research (Kruesi, Burstein & Tanner, 2019).

A few key national challenges were summed up at the Australian eResearch Skilled Workforce Summit held in 2019 at The University of Sydney. The summit identified that a national approach to a shared model to achieve an eResearch Skilled Workforce or shared training resources will need good governance mechanisms and clear ownership and responsibility to maintain quality and continuous improvement. There is a need for research offices to work with library services and a need to rejig and continue developing librarian roles in order to teach eResearch skills at universities. Bodies, for example, the Australian Research Data Commons, the Council of Australian University Librarians and Open Access Australasia, are working to address some of these challenges by pursuing national initiatives (Australian Research Data Commons; Barbour & Bradley, 2021).

Whilst Europe and the US have similar internal challenges with having differences in relation to open science priorities, they have been able to achieve success with international, regional and national initiatives. Country-wide approaches have been effective and are ongoing, with the European Plan S underway in 2021, after more than a decade of planning, and the US National Institutes of Health Public Access Policy successfully applied since 2008 (European Science Foundation, 2021; US Department of Health and Human Services, 2008).

Achieving Australia's National Digital Health Strategy requires networks of healthcare academics, researchers and supporting information professions to collaborate on a system that is respected by health consumers as safe, seamless and secure (Australian Digital Health Agency, 2021). The conceptual KMS framework is a powerful tool that can be used to align the components that underpin the effectiveness and sustainability of an Australasia OBR. It is a tool to assist in the transition from organizational silos to an open science environment. Adoption of the framework can ultimately assist research communities to foster world-class

collaboration and corroboration through systematic and coordinated effort, informed by KM theory and practice.

Repository challenges

The need for archiving and making openly accessible national and regional substructures of research output is evidenced by the establishment of Europe PMC in 2007, followed by PMC Canada in 2009, as PMC International (US National Library of Medicine, 2018). In 2018, PMC Canada ceased operation, alleging that institutional repositories could replace their role. In Australia, institutional repositories achieve low levels of compliance with funder open access policies; they have no coordinating authority and often suffer from lack of resources (Council of Australian University Librarians, 2017). In contrast, because of their effective processes, the US National Institutes of Health and Wellcome Trust achieve compliance rates around 90%, which are underpinned by US PMC and Europe PMC repositories respectively (Kirkman & Haddow, 2020; Lariviere & Sugimoto, 2018).

There are no formal measures of university compliance with open access requirements of funding bodies in Australia. PMC International has been able to achieve high levels of compliance, as publishers submit author content to the repository in most cases and penalties for researchers exist if they do not comply with open publishing processes. The work of publishers to provide the accepted article *content* removes the submission burden from the researcher and is a key reason why the PMC model is effective.

The closure of PMC Canada suggests that some of the challenges for sectors within the healthcare industry, government and universities, to work together are difficult to resolve. The success of establishing a PMC in the European region is counter to the experience in Canada. A major reason why PMC Canada went offline in 2018 was due to the growth in Canadian institutional repositories and other technology systems that superseded those of PMC Canada. In the later period of PMC Canada's operation, there was evidence of a lack of balance with its management of KM processes—and the *technology, people,* repository and *content* dimensions of each process. The imbalance in PMC Canada's KM processes contributed towards the breakdown of this system.

Formalities exist to become a member of PMC International. An agreement with Europe PMC to establish an Australasia OBR may be the viable solution to overcome the identified threats of lack of commitment from a national or regional body. Improving biomedical knowledge management processes in the Australasian region may be possible from adopting an OBR for consolidated storage, retrieval and transfer processes of research output that is linked to its underlying data. This in turn could put regional biomedical research under a stronger spotlight and potentially lead to improvements with research quality. The amount of content available from an open consolidated repository, in particular for data and text mining, will grow if Europe PMC and an Australasia OBR could combine forces. This also would contribute to the range of bio-reports that are possible, with flow-on benefit to industry and those groups often excluded from public research due to journal subscription paywalls.

Plan S, an initiative for open access publishing, released in 2018 and supported by cOAlition S, required that from 2021, scientific publications resulting from research funded by public grants, be published in journals or platforms that are open access compliant (European Science Foundation, 2021). Europe PMC fully supports the mission of Plan S to drive universal open access for research articles (Europe PMC, 2019). Many of the cOAlition S funders use Europe PMC as their repository for deposit of their publication outputs from publicly funded

biomedical projects. Europe PMC meets all the requirements outlined in the implementation plans and points out that this approach provides the best opportunity for discovery, interoperability and reuse of the full-text content of research articles, and therefore contributes effectively to open science (Europe PMC, 2019).

Recent research has found that the proportion of green open access articles could be greatly increased if New Zealand authors utilised the rights afforded to them by publishers to make versions of their work freely accessible in non-commercial repositories. Fully 3,089 (88%) of closed articles could be made available in this way, but the 2017 sample identified only 125 articles in New Zealand's institutional repositories (White et al., 2021). Greater collaboration between Australasian health librarians in universities, hospitals, healthcare organisations and medical research bodies is recommended to overcome obstacles to implementing and advancing open science in the region.

An Australasia OBR fits with the objective of making Australia's publicly funded research outputs F.A.I.R. (Findable, Accessible, Interoperable, Reusable). It presents opportunities to enhance the clinical research cycle process and optimise Australasian biomedical research through the establishment of a permanent archive available to all.

The vast majority, if not all, Australasia repositories at present do not comply with the technical requirements of Plan S. Nevertheless, Europe PMC is one of the few repositories that does comply with Plan S, and strengthening its adoption in the Australasian region would be a means to achieve immediate open access to publications from publicly funded research.

Health librarianship challenges

The key barriers users experience when they try to access information in a clinical environment have been identified by recent research (Laera et al., 2021). Eight major pain-points in accessing information were identified by the study and include access, paywalls, resource platforms, resource scope, awareness, integration, financial limitations and time (Laera, Gutzman, Spencer, Beyer et al., 2021). It is not feasible for all content to be made open access, although adoption of the KMS framework for the introduction of an OBR has scope to address many of the pain-points raised. Use of the KMS framework to analyse and assess information systems is a means to determine the benefits and pitfalls that can be communicated to users. The KMS framework is a means for librarians to identify key components and lobby for them across information systems to improve the user experience.

Ongoing professional development of the health library profession to deal with the challenges of supporting the scholarly communication and research needs of users is a constant requirement (Shaffer, 2021). With the devastating financial impact from the loss of international students to Australian universities because of border closures due to the COVID-19 pandemic, Australian academic libraries in 2021 were experiencing cut-backs as a consequence (Kent, 2021). It is time to question any further duplication of effort that occurs with library services in the academic sector. Whilst most Australian library universities have discovery systems, it is recommended that the curation of national or regional repository collections be considered to help rationalise existing duplication. With the management of print collections, the constant curating, such as updating editions, creating room for storage, removing out-of-date copies and repair of texts to maintain onsite physical collections was necessary. With digital information platforms and repositories, a radical rethink and redesign is possible and necessary.

The increasing presence of open access articles is transforming the scholarly communications landscape. With the advent of openly accessible research resources, disruption to the library's key role as the major provider of information resources, such as research databases and reference tools, from its discovery platform has occurred over the past ten years (Dahl, 2021). Movements such as the Initiative for Open Abstracts ("Initiative for open abstracts," 2020) are contributing to the effort to open up abstracts and make research output more discoverable. Traditionally only proprietary databases had a monopoly requiring a subscription to search article abstracts. It is recommended that library services gradually move on from the large package consortia 'big-deals' model that have been in place since the 1990s and investigate opportunities afforded from transformative agreements and the wider adoption of suitable information repositories for their users (Wise & Estelle, 2020).

Kennan, Kingsley and Richardson have argued for consideration of a range of formats and options for health librarians in the establishment of professional development on emerging roles in scholarly communication (Kennan, Kingsley & Richardson, 2021). At a Workshop conducted with a library colleague from the University of Bucharest for this research, it was identified that library students focused on traditional, information services processes, rather than appraising aspects such as content discoverability and interoperability. It would be beneficial to test the KMS framework further and explore the opportunity to help library students and librarian practitioners adopt a wider paradigm for the analysis of information platforms and repositories.

Research Implications

PMC International comprised the US PMC, Europe PMC and PMC Canada, when the interviews and the focus group took place. Views on the potential for an Australasia OBR obtained from participants were not as an alternative to the existing solution—that is, institutional repositories—but as a chance to explore the Strengths Weaknesses, Opportunities and Threats of a PMC in the region (Kruesi, Burstein & Tanner, 2019).

The COVID-19 pandemic has accentuated the need for action to open up the output from research and development universally and design systems that are sustainable (Alemneh et al., 2020). Based on the investment to date in repositories such as PMC International and other world open databases, it has been possible to leverage these systems and the usage figures illustrate that reliance upon such research output is of an immense magnitude. To date more than 50 publishers have made their coronavirus content available in PMC and at January 2022, 210,000 articles in PMC's coronavirus collection under this initiative have been accessed more than 275 million times (NLM Program Manager, 2022; US National Library of Medicine, 2021).

Even so, there are reports that the research evidence pipeline is cracking. There is a need to collaborate in order to improve the quality, the speed of production and the delivery of improvements and new discoveries to improve human healthcare (Fix medicine's evidence pipeline [Editorial], 2021). The key opportunities for a potential Australasia OBR identified by this research were: greater discoverability and accessibility of biomedical regional research output, greater sharing of repository expertise, consolidation, improved copyright compliance, data-set integration and an increased provision of mineable and reusable content. The opportunity for an Australasia OBR to overcome threats, such as the present inadequacy of existing repository and information resource access, and to address the problem of limited available funding to ensure longevity of an OBR for the Australasian region, remains to be tested.

The adoption of formalised KM processes could potentially result in significantly improved biomedical information systems (Becerra-Fernandez & Sabherwal, 2015). There is a great opportunity for a body such as the NHMRC to take a leadership role in consolidating the present fragmented approach to the management of biomedical information by linking the research output to evidence of impact and improvements for society.

The KMS framework for an OBR demonstrated the significance of the interplay of existing services and resources. A repository is not just a technology—it is a set of systems and services that facilitates the ingestion, storage, management, retrieval, display, and reuse of digital objects (Pinfield, 2009). A key finding is the significance of the *people, process* and quality *content* to the success of a repository and the criticality of the *technology*, although it is merely a vehicle for transporting the research *content* through its life-cycle. The inclusion of the entire biomedical KM processes in the design of an information system is potentially a way to speed up the transfer and translation of primary knowledge in the research pipeline. Use of the KMS framework is a means to identify road-blocks in getting evidence to the apex of the evidence-based healthcare pyramid. The adoption of the framework is a powerful means to identify the extent to which open scholarship processes and elements already exist and what remains to fill the gaps to achieve a sustainable open scholarship OBR system.

As a senior biomedical researcher concisely summed up, 'As we increase Open Access to make knowledge more accessible and if an Australasia PMC does this, it would be worthwhile. It is not just about clinicians accessing an Australasia PMC. The ways it would contribute are diverse; an Australasia PMC would be accessible to consumers and this is important.' (Interview participant, Head biomedical researcher, male, Queensland). A blueprint for a sustainable Australasia OBR is one way forward.

The open science movement has gained significant momentum over the past two decades. Over this time, institutional and disciplinary repositories have significant KM process roles throughout the biomedical knowledge creation stages of discovery, creation, representation, classification, storage, retrieval, dissemination, transfer and translation (Kruesi, Burstein & Tanner, 2020). There are further opportunities for repositories to work together to achieve the FAIR principles.

During this research, the field of data management has grown significantly—data has become the 'new gold'. Research integrity is demonstrated by linking articles to their research data. Data driven discovery has become a major objective for organisations such as the US National Library of Medicine. Visualisation of research output and results has become increasingly important, e.g., the growth of platforms such as *Impactstory*.

KM processes can inform the design for a successful regional or national PMC and this was the objective of the third cycle of this action research project. Opportunity exists to test this theory claim through the development of an Australasia OBR. According to senior staff from the National Library of Australia, KM process principles were a key reason for the success of their legal deposit online system. Senior NLM staff indicated the balance of *technology, people, process* and *content* were essential to the new legal edeposit system, NED, that has been implemented throughout the National and State libraries in Australia (National Library of Australia, 2018).

In November 2018, the Council of Australian University Librarians (CAUL) and the Australasian Open Access Strategy Group's (AOASG) submission on establishing a strategic approach to open scholarship was recognised in a report by a Standing Committee on Employment, Education and Training. According to Ginny Barbour, Director of Open Access Australasia 'we should publish research as a fully interconnected, purposefully designed,

equitable, global scholarly ecosystem supported by a wide variety of open access publishing models, underpinned by sophisticated linking of well-curated, interoperable research articles and other outputs, including data and software' (Barbour, 2018). The emphasis is on removing barriers to the effective dissemination of knowledge.

Evidence exists of the success and pervasive nature of PMC International as a repository. Reports include PMC being able to satisfy funder requirements to publish open access articles within twelve months or earlier (Lariviere & Sugimoto, 2018). Other evidence of Europe PMC's effectiveness is evident from the ongoing development of system features and services that are wide-ranging, such features that allow reporting on grants and research findings, author profiles linked to ORCID, text mining, related articles and an annotations service (Europe PMC, 2018, 2019).

A PMC itself is not a panacea for all regions. A PMC requires a very significant investment and strict qualifications exist to become a member of PMC International. It is the PMC model that is available to all open access biomedical repositories and is worthy of attention. Working with Europe PMC may be a suitable starting point to commence development of an open access biomedical repository for the Australasian region.

How repositories point to the essential global libraries of living systematic reviews that report concisely on issues such as vaccine roll-out to recovery and school closures, is of critical importance in particular during a global pandemic. Establishment of an Australasia OBR is a means to have a quality website of essential medical and health sciences library knowledge, that can include prominent links to the essential global libraries.

Future research

Based on the increase of full-text content added by publishers to PMC during the COVID-19 pandemic, measuring how much Australasian content is now available from the repository is recommended (SPARC, 2020). Ensuring the full-text content is available from PMC International is a means to partially address the problems of fragmentation, accessibility, discoverability, interoperability, reusability and permanency of biomedical research outputs. To help avoid duplication of effort and increase collaboration, further research is recommended to explore the relationships between, and the future of, library discovery systems, university publishing presses and repositories in the Australasian region. Greater optimisation of existing information systems such as Trove and other relevant Australasia open systems in collaboration with PMC International should be pursued.

In 2019, only 43 per cent of research publications associated with Australian authors were open access (Neylon & Montgomery, 2020). It is timely to learn from our neighbour, Indonesia, which has achieved an open access rate of more than 80 per cent (Neylon & Montgomery, 2020). In addition, this research identified that Korea has also had discussions with the US NLM in regard to establishing a PMC (NLM Program Manager, 2019). Future collaboration with other Asia-Pacific partners to advance open science would be of potential benefit to the Australasian region.

The impact of improved retrieval and automation tools is speeding up time to complete systematic reviews. It is important to investigate the potential to include these tools in the design of repositories (Clark et al., 2020; Marshall & Wallace, 2019). Evaluations of other information platforms and repositories help to identify gaps and provide opportunities to improve existing repository design. It is recommended that the KMS framework be further

developed as a tool for application across multi-disciplinary and interdisciplinary information systems.

In recognition of the importance and future potential of multi-disciplinary and inter-disciplinary research, it will be important to shift knowledge out of silos, such as the closed databases, for example the Australian Informit databases and platforms. Even open systems, such as Epistemonikos, are not necessarily well known to health researchers to enhance discovery of research output across all fields.

It would be beneficial to test the KMS framework further and explore the opportunity to help library students and librarian practitioners adopt a wider paradigm for the analysis of information platforms and repositories. The focus over recent decades for librarians has been on electronic information resources. This research has demonstrated the wider KM processes that are integral to biomedical information systems and developing deeper librarians' understanding of the elements and processes will contribute to establishing an ongoing, sustainable open scholarship environment.

Lastly, future research is required to reflect and further test the strengths and weaknesses of the *people*, *process*, *technology* and *content* elements and the overall transferability of the KMS framework to multi-disciplinary and interdisciplinary information systems.

Conclusion

A key benefit of establishing an ongoing Australasia OBR with PMC International is the consolidation of health and medical research locally and internationally. Whilst researchers may be satisfying Australian funder requirements to publish openly, most are paying gold open access fees to make research output available from journal websites and this is resulting in fragmented knowledge that is not readily discoverable by other researchers and members of the public.

Requirements to achieve open access publishing highlighted by Plan S are rigorous and controversial. High standards for open access publishing are essential and collaborating with publishers to achieve innovation in scholarly publishing is vital.

The COVID-19 pandemic has reminded us that biomedical research is a global concern and heightened the essential need to develop future systems that ensure our health knowledge is authoritative and reliable (Alemneh, Hawamdeh, Chang, Rorissa et al., 2020). Biomedical researchers need to navigate specific content and data tailored to research needs. We need to overcome the pain-points highlighted in present biomedical information systems and create reliability and quality when we bring together future OBR KMS (Laera, Gutzman, Spencer, Beyer et al., 2021).

Since the COVID-19 pandemic, universities in Australia have suffered major revenue shortfalls, in particular with the loss of international student enrolments. It will be imperative that universities work together to manage knowledge more efficiently in the future hence—a national or regional institutional repository solution should be pursued.

There is a great opportunity to accelerate the advancement of scholarly publishing through open access biomedical repositories. A KMS framework for a gold standard OBR is a means to build on the present foundation and achieve sustainable open scholarship, that can underpin connecting, engaging, and ultimately improving health and saving lives.

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References

Alemneh, D. G., Hawamdeh, S., Chang, H. C., Rorissa, A., Assefa, S., & Helge, K. (2020). Open access in the age of a pandemic. *Proceedings of the Association for Information Science and Technology, 57,* e295. https://doi.org/10.1002/pra2.295

Australian Digital Health Agency. (2021). National Digital Health Strategy and framework for action. Retrieved from https://www.digitalhealth.gov.au/about-us/national-digital-health-strategy-and-framework-for-action (accessed 20 June 2021).

Australian Library and Information Association. (2008). *ALIA-HLA submission to the National Health and Hospitals Reform Commission*. Retrieved from https://read.alia.org.au/alia-hla-submission-national-health-and-hospitals-reform-commission-july-2008

Australian Research Data Commons. National Data Assets. Retrieved from https://ardc.edu.au/collaborations/strategic-activities/national-data-assets/ (accessed 10 June 2021).

Barbour, V. (2018). *Accessing the outputs of research: will "traditional peer reviewed publication" become a relic of the past?* . Paper presented at the National Health and Medical Research Council, The Reward Alliance. Seventh Annual NHMRC Symposium on Research Translation: Ensuring Value in Research, Sydney. Retrieved from https://vimeo.com/album/5683547

Barbour, V., & Bradley, F. (2021). A renewed impetus for open research in Australia. *IAU Horizons, 26*(1), 28-29.

Becerra-Fernandez, I., & Sabherwal, R. (2015). *Knowledge management: systems and processes* (2nd ed.). New York, NY: Ebooks Corporation.

Clark, J., Glasziou, P., Del Mar, C., Bannach-Brown, A., Stehlik, P., & Scott, A. M. (2020). A full systematic review was completed in 2 weeks using automation tools: a case study. *Journal of clinical epidemiology, 121*, 81-90. https://doi.org/10.1016/j.jclinepi.2020.01.008

Council of Australian University Librarians. (2017). *Current State of Open Access: Briefing Paper for Universities Australia (UA) Deputy Vice-Chancellors Research Committee: Agenda item 3154a. CAUL Executive Meeting 2017/6*. 1-10.

Dahl, M. (2021). The evolving role of library collections in the broader information ecosystem. In D. Baker & L. Ellis (Eds.), *Future directions in digital information: predictions, practice, participation* (pp. 161-174). Cambridge, MA: Elsevier.

Europe PMC. (2018). How does the author manuscript in Europe PMC differ from the article published in the journal? Retrieved from https://europepmc.org/Help#EPMCauthmandiffjournal (accessed February 10).

Europe PMC. (2019). Europe PMC's response to the implementation guidance of Plan S. *Blog - Europe PMC.* Retrieved from http://blog.europepmc.org/2019/02/europe-pmc-plan-s-feedback.html (accessed 19 June 2021).

European Science Foundation. (2021). 'Plan S' principles and implementation. Retrieved from https://www.coalition-s.org/addendum-to-the-coalition-s-guidance-on-the-implementation-of-plan-s/principles-and-implementation/ (accessed 20 May 2021).

Ferguson, J. (2021). Covid-19: Melbourne outbreak shows flaws in hotel quarantine, vaccine rollout. *The Australian*. Retrieved from https://www.theaustralian.com.au/commentary/covid19-melbourne-outbreak-shows-flaws-in-hotel-quarantine-vaccine-rollout/news-story/09f0771fad8923fea0baf603dfa75280

Fix medicine's evidence pipeline [Editorial]. (2021, 13 May). *Nature 593,* 168. Retrieved from https://media.nature.com/original/magazine-assets/d41586-021-01255-w/d41586-021-01255-w.pdf

Initiative for open abstracts. (2020). Retrieved from https://i4oa.org/ (accessed 20 June 2021).

Kennan, M. A., Kingsley, D., & Richardson, J. (2021). Scholarly communication knowledge and skills in hospital and health services libraries: Report of a survey. *Journal of Health Information and Libraries Australasia, 2(1).* Retrieved from https://www.johila.org/index.php/Johila

Kent, P. (2021). *Our future: diversified or diluted?* Paper presented at the CAVAL CRIG / PDIG joint forum 25 May 2021. Retrieved from https://members.caval.edu.au/media/images/Documents/OurFuture/Speaker_2_Philip_Kent.pdf

Kruesi, L. (2021a). *A Knowledge Management System framework to critique open science platforms and repositories.* Paper presented at the MLA '21: Transforming Our Diversifying Communities Annual Meeting, Virtual. Retrieved from https://www.mlanet.org/mla21

Kruesi, L., Burstein, F., & Tanner, K. (2020). A knowledge management system framework for an open biomedical repository: communities, collaboration and corroboration. *Journal of Knowledge Management, 24*(10), 2553-2572. doi:https://doi.org/10.1108/JKM-05-2020-0370

Kruesi, L. M. (2021b). *Conceptualisation of an Australasia Open Biomedical Repository from a Knowledge Management System Perspective.* (Doctoral dissertation). Monash University, Retrieved from https://bridges.monash.edu/articles/thesis/Conceptualisation_of_an_Australasia_Open_Biomedical_Repository_from_a_Knowledge_Management_System_Perspective/16624996

Kruesi, L. M., Burstein, F. V., & Tanner, K. J. (2019). With open science gaining traction, do we need an Australasia PubMed Central (PMC)? A qualitative investigation. *PLOS ONE, 14*(2), e0212843. https://doi.org/10.1371/journal.pone.0212843

Kruesi, L. M., Burstein, F. V., Tanner, K. J., & Todd, H. (2018, 27-28 November). *Ensuring value of Australasia research from improving knowledge management processes [Poster]*. Paper presented at the National Health and Medical Research Council, The Reward Alliance. Seventh Annual NHMRC Symposium on Research Translation: Ensuring Value in Research, held 27-28 November, Sydney, NSW. Retrieved from https://www.nhmrc.gov.au/event/2018-nhmrc-symposium-research-translation

Kruesi, L. M., Tanner, K., & Burstein, F. (2019). Advancing scholarly publishing through open access biomedical repositories: A knowledge management perspective. *IFLA Journal, 45(3),* 233-245. Retrieved from https://www.ifla.org/files/assets/hq/publications/ifla-journal/ifla-journal-45-3_2019.pdf

Kruesi, L. M., Tanner, K. J., & Burstein, F. V. (2018). *Knowledge Management theory and the Evidence-Based Healthcare Model to guide the design for an Australasia Open Biomedical Repository*. Paper presented at the IFLA WLIC 2018, Transform Libraries, Transform Societies, 84th IFLA General Conference and Assembly Kuala Lumpur, Malaysia Retrieved from http://library.ifla.org/id/eprint/2184

Laera, E., Gutzman, K., Spencer, A., Beyer, C., Bolore, S., Gallagher, J., . . . Rodriguez, R. (2021). Why are they not accessing it? User barriers to clinical information access. *J Med Libr Assoc, 109*(1), 126-132. doi:10.5195/jmla.2021.1051

Lariviere, V., & Sugimoto, C. R. (2018). Do authors comply with mandates for open access? *Nature, 562*(7728), 483-486. doi:10.1038/d41586-018-07101-w

Marley, J. (2016) *Cycle One PMC interview/Interviewer: L. Kruesi*.

Marshall, I. J., & Wallace, B. C. (2019). Toward systematic review automation: a practical guide to using machine learning tools in research synthesis. *Systematic reviews, 8*(1), 1-10.

National Library of Australia. (2018). Legal deposit. Retrieved from https://www.nla.gov.au/legal-deposit (accessed 22 March 2021).

Neylon, C., & Montgomery, L. (2020). A win for research open access. *Campus Morning Mail.* Retrieved from https://campusmorningmail.com.au/news/a-win-for-research-open-access/ (accessed 10 June 2021).

NLM Program Manager. (2019, 12 April 2019) *Update on PMC/Interviewer: L. Kruesi*.

NLM Program Manager. (2022, 12 January 2022) *Usage of the PMC coronavirus collection [email correspondence]*.

Pinfield, S. (2009). Journals and repositories: an evolving relationship? *Learned Publishing, 22*(3), 165-175.

Roberts, R. J. (2001). PubMed Central: The GenBank of the published literature. *Proc Natl Acad Sci U S A, 98*(2), 381-382. https://doi.org/10.1073/pnas.98.2.381

Shaffer, C. (2021). The move to open: medical library leadership in scholarly communication. *J Med Libr Assoc, 109*(1), 1. https://doi.org/10.5195/jmla.2021.1127

SPARC. (2020). Strong community response to free scholarly article access to fight COVID-19. Retrieved from https://sparcopen.org/news/2020/strong-community-response-to-free-scholarly-article-access-to-fight-covid-19/ (accessed 24 May 2021).

Steele, C. (2013). Open access in Australia: an odyssey of sorts? *Insights, 26*(3), 283-289. doi:.org/10.1629/2048-7754.91/

US Department of Health and Human Services, National Institutes of Health. (2008). NIH Public Access Policy. Retrieved from https://publicaccess.nih.gov/policy.htm (accessed 27 June 2021).

US National Library of Medicine, National Institutes of Health. (2018, 6 May 2021). PMC International. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/about/pmci/ (accessed 17 August 2020).

US National Library of Medicine, National Institutes of Health [Website]. (2021). Public Health Emergency COVID-19 Initiative. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/about/covid-19/ (accessed 11 January 2022).

White, R. K. A., Angelo, A., Fitchett, D., Fraser, M., Hayes, L., Howie, J., . . . White, B. (2021). Only two out of five articles by New Zealand researchers are free-to-access: a multiple API study of access, citations, cost of Article Processing Charges (APC), and the potential to increase the proportion of open access. *PeerJ (San Francisco, CA), 9*, e11417. doi:10.7717/peerj.11417

Williamson, P. O., & Minter, C. I. (2019). Exploring PubMed as a reliable resource for scholarly communications services. *J Med Libr Assoc, 107*(1), 16-29. doi:10.5195/jmla.2019.433

Wise, A., & Estelle, L. (2020). How society publishers can accelerate their transition to open access and align with Plan S. *Learned Publishing, 33*(1), 14-27. https://doi.org/10.1002/leap.1272