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User-centred design in indicator development: Involving the biomedical community in building an open science dashboard[1]

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Introduction

National and international policies increasingly demand that open science be made a priority and an increasing number of government and private funders mandate that researchers publish open access, share their data, code and materials. In November 2021, UNESCO (2021) adopted its Recommendation on Open Science and urged its 193 member states to take action towards achieving open science globally. The recommendation followed efforts from the global community of funders and cemented the importance of open science as a global priority.

However, despite these recommendations and mandates, the academic community has been slow to adopt and implement open science practices. This is thought to be largely due to the

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academic reward system being tied to traditional, closed research outputs and practices (Alperin et al., 2022). To a large extent, what 'counts' in career advancement is the number of publications in prestigious–typically high impact, paywalled–journals, rather than efforts towards making research more accessible, transparent and reusable (Ali-Khan et al., 2017; McKiernan et al., 2019). Open access publishing, arguably the most established open science practice, has been shown to increase significantly when compliance is monitored (Larivière & Sugimoto, 2018). The UNESCO recommendation specifically emphasises the importance of monitoring to implement open science practices. Scholarly metrics that capture open science practices such as data sharing (Lowenberg et al., 2019) have been suggested to help researchers showcase outputs and impact beyond traditional peer-reviewed journal articles.

While the development of bibliometric (and altmetric) indicators is typically data driven, in the sense that metrics were developed from available metadata, this research-in-progress takes a user-centred design approach. We report findings from a modified Delphi study, where we asked members of the biomedical community to identify open science practices to include in an institutional-level automated digital dashboard.

Methods

Delphi studies structure communication between experts to establish consensus and typically use several rounds of surveys to vote on specific issues. Between rounds, votes and feedback are aggregated and anonymized and then presented back to participants (Linstone & Turoff, 2011). A strength of this method of communication is that it allows all individuals in a group to communicate their views. Anonymous voting also limits direct confrontation among individuals and the influence of power dynamics and hierarchies on the group's decision. We conducted a 3-round modified Delphi study with two rounds of online surveys using Surveylet and two half-day consensus meetings hosted on Zoom (round 3) to allow for more nuanced discussions among participants. Participants voted on a total of 34 open science practices. Consensus was defined as 80% agreement. The protocol for the Delphi study is available online (Cobey et al., 2021)**.**

Participants were recruited using a snowball sampling approach among institutions that are supportive of and interested in monitoring open science practices. We initially recruited 32 institutions from 22 countries. We invited institutional leadership to each identify four to six members to participate in the Delphi. 80 participants from 20 institutions in 13 countries completed round 1 of the survey, while 56 participants from 19 institutions completed round 2. In order to ensure feasibility of discussions via Zoom, we randomly sampled participants for the consensus meeting (round 3), of which 21 were present on day 1 and 17 on day 2. After completion of round 3, participants were sent the list of open science practices that reached consensus and asked to rank order their relative importance for inclusion in the dashboard. 17 participants completed the prioritisation exercise.

Results from Delphi study

Participants voted on a total of 34 open science and broader transparency practices, 19 of which reached consensus during the various rounds of the modified Delphi (see Table 1). No consensus was reached for 15 practices, which, for example, included the use of open lab notebooks, open peer review, Research Resources Identifiers (RRID) or sharing of research data management plans. Of the 19 practices that reached consensus, two practices were voted in during the first round, namely registration of clinical trials before recruitment started and sharing of study data at the time of publication (with limited exceptions). An additional five practices reached consensus in round 2, including the reporting of whether study code was

shared openly at time of publication (with limited exceptions), the use of reporting guidelines, reporting of author conflicts of interest, author contributions and ORCIDs. The remaining 12 practices were voted in round 3 after discussions during the consensus meeting.

After completion of round 3, participants were asked to prioritise the 19 practices for inclusion in the dashboard. Based on discussions during the consensus meeting, items were split into two categories of 'traditional open science practices' and 'broader transparency practices'. The open science practices that were ranked as most important were registration of clinical trials, data sharing, open access publishing and sharing of code (Table 1).

Table 1. Open science and broader transparency practices that reached consensus for inclusion

Item	**Practice**	**Round where consensus was reached**	**Priority score**
Traditional open science practices			
1	Reporting whether clinical trials were registered before they started recruitment	1	9.71
2	Reporting whether study data was shared openly at the time of publication (with limited exceptions)	1	9.18
3	Reporting what proportion of articles are published open access with a breakdown of time delay	3	8.12
4	Reporting whether study code was shared openly at the time of publication (with limited exceptions)	2	7.94
5	Reporting whether systematic reviews have been registered before data collection began	3	6.76
6	Reporting whether clinical trials results appeared in the registry from 1 year after study completion	3	6.76
7	Reporting whether there was a statement about study materials sharing with publications	3	6.00
8	Reporting whether a reporting guideline checklist was used	2	5.88
9	Reporting citations to data	3	5.53
10	Reporting trial results in a manuscript-style publication (peer reviewed or preprint)	3	4.82
11	Reporting the number of preprints	3	4.35
12	Reporting systematic review results in a manuscript-style publication (peer reviewed or preprint)	3	2.94
Broader transparency practices			
1	Reporting whether author contributions were described	2	5.12
2	Reporting whether author conflicts of interest were described	2	4.71
3	Reporting the use of persistent identifiers when sharing data/code/materials	3	4.65
4	Reporting whether ORCID identifiers were used	2	4.47
5	Reporting whether data/code/materials are shared with a clear license	3	3.47
6	Reporting whether research articles include funding statements	3	3.00

7	Reporting whether the data/code/materials license is open or not	3	2.59

Dashboard development

The open science practices identified will be used to inform the development of an automated open science dashboard which can be deployed by biomedical institutions to efficiently monitor adoption and educate researchers in various open science practices. The dashboard will build on previous work by our team, including the *Charité Dashboard on Responsible Research* and the *Curtin Open Knowledge Initiative (COKI) Open Access Dashboard*. It will be implemented using open-source code, and require no intervention, bureaucracy or reporting on the part of the researcher. By establishing what should be reported in an institutional open science dashboard through a consensus building process with relevant stakeholders, we aim to ensure the tool is appropriate to the needs of the community. This approach might also increase the chances of uptake and implementation. Our approach might also be useful to other disciplines contemplating institutional dashboards.

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