The essential role of librarians in addressing biomedical research reporting and reproducibility issues: a call to action

Shona Kirtley

Senior Research Information Specialist | EQUATOR Network | Centre for Statistics in Medicine | NDORMS | University of Oxford

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CSM

NDORMS
NUFFIELD DEPARTMENT OF ORTHOPAEDICS, RHEUMATOLOGY AND MUSCULOSKELETAL SCIENCES

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Presentation outline

- What is research reproducibility?
- Concerns regarding research reproducibility in biomedical research
- What is currently being done to address issues of research reproducibility?
- Can librarians help to address research reproducibility concerns in biomedical research and if so how?
- What impact could librarians have?
- Key messages

What is research reproducibility?

- Terminology not always consistently or correctly used leading to lack of clarity and confusion

- The National Science Foundation (NSF) defines **'reproducibility'** as

"the ability of a researcher to duplicate the results of a prior study using the same materials and procedures as were used by the original investigator".

- The NSF states that

"Reproducibility is a minimum necessary condition for a finding to be believable and informative".

https://www.nsf.gov/sbe/SBE_Spring_2015_AC_Meeting_Presentations/Bollen_Report_on_Replicability_SubcommitteeMay_2015.pdf
Accessed 3 May 2017.

What is research reproducibility? (2)

- **'replication'** & **'replicability'** are terms often used when reproducibility is discussed
- but there is a distinct difference in meaning between **'reproducibility'** and **'replicability'**

- **'Replicability'** is defined by the National Science Foundation as

"the ability of a researcher to duplicate the results of a prior study if the same procedures are followed but new data are collected".

What is research reproducibility? (5)

Science 101: the basics of reproducibility

Brian Nosek, Psychology Professor at the University of Virginia and the President and Director of the Center for Open Science

https://www.youtube.com/watch?v=lvw4HBl8Lyo

What is research reproducibility (4)

- 4 main aspects of reproducibility:
  - **Methods** (detailed enough description of each step of the study methods and data for it to be repeated)
  - **Results** (can the results of the study be replicated)
  - **Inferential** (can groups performing analysis on the same data reach the same conclusions)

(first three based on Goodman SN, Fanelli D, Ioannidis JP. What does research reproducibility mean? Sci Transl Med. 2016 Jun 1;8(341):341ps12).

  - **Laboratory methods and materials** (detailed enough information about the materials (e.g. cell lines) and laboratory methods (e.g. conditions, storage) to allow them to be accurately reproduced)

Concerns about reproducibility in biomedical research (1)

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Estimating the reproducibility of psychological science

Open Science Collaboration*,†
+ See all authors and affiliations

Science 28 Aug 2015:
Vol. 349, Issue 6251, aac4716
DOI: 10.1126/science.aac4716

"A large portion of **replications produced weaker evidence for the original findings** despite using materials provided by the original authors, review in advance for methodological fidelity, and high statistical power to detect the original effect sizes"

Editorial

For reprint orders, please contact: reprints@futuremedicine.com

Biomarkers in Medicine

Reproducibility in biomarker research and clinical development: a global challenge

"Implementation of an academic quality system will contribute to a better understanding of and trust in the quality and validity of research results..."

PLOS BIOLOGY

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META-RESEARCH ARTICLE

Reproducible Research Practices and Transparency across the Biomedical Literature

Shareen A. Iqbal, Joshua D. Wallach, Muin J. Khoury, Sheri D. Schully, John P. A. Ioannidis

Published: January 4, 2016 • https://doi.org/10.1371/journal.pbio.1002333

PLOS ONE | Publish | About | Brow

"When asked about questionable research practices, survey respondents were aware of other researchers who **selectively reported study outcomes (41%) and experimental conditions (36%), adjusted statistical analysis to optimise results (43%),** and engaged in other shady practices (20%). Fewer respondents admitted to engaging in these practices themselves, although 25% admitted to adjusting statistical analysis to optimize results. **There was strong agreement that such practices should be reported in research papers**..."

Questionable science and reproducibility in electrical brain stimulation research

Martin E. Héroux, Colleen K. Loo, Janet L. Taylor, Simon C. Gandevia

Published: April 26, 2017 • https://doi.org/10.1371/journal.pone.0175635

nature.com ▸ journal home ▸ archive ▸ issue ▸ perspectives ▸ opinion ▸ full text

NATURE REVIEWS CLINICAL ONCOLOGY | PERSPECTIVES | OPINION

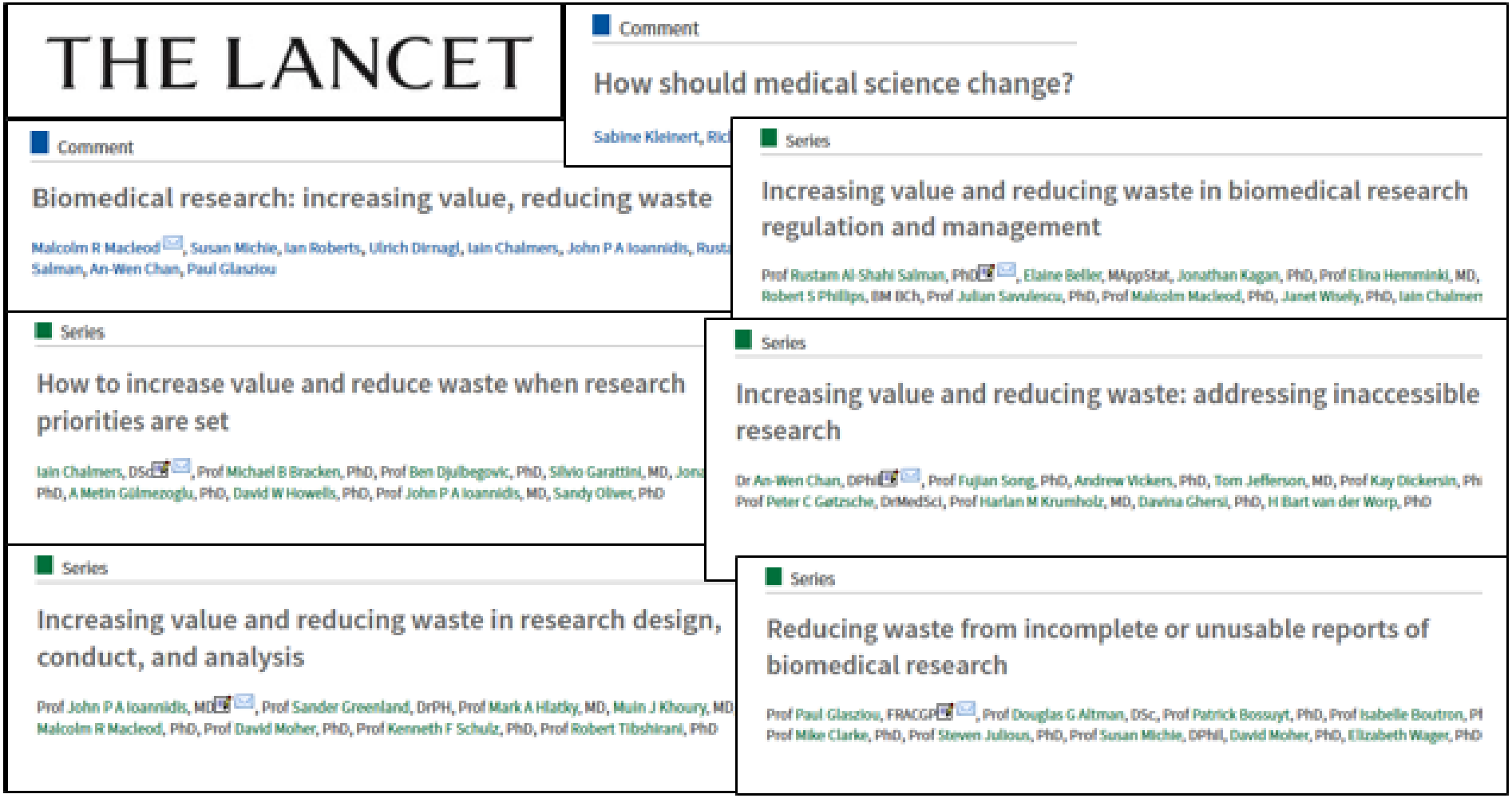
Reproducibility of research and preclinical validation: problems and solutions

Lajos Pusztai, Christos Hatzis & Fabrice Andre

Affiliations | Contributions | Corresponding author

Nature Reviews Clinical Oncology **10**, 720–724 (2013) | doi:10.1038/nrclinonc.2013.171

Concerns about waste in biomedical research



Concerns about reproducibility in biomedical research (2)

Many factors contribute to irreproducible research studies.

- Key study-related factors include:
  - poor study design
  - inadequate sample size
  - use of inappropriate statistical analysis techniques
  - poorly controlled experimental conditions
  - lack of detailed documentation/recording of study procedures/methods (e.g. laboratory notebook)
  - poor reporting of study design and methods in publications
  - selective reporting of results
  - unavailability of data

- Key external factors include:
  - pressure to publish
  - peer review
  - lack of outlets for publishing 'negative' results
  - conflicts of interest

Concerns about reproducibility in biomedical research (3)

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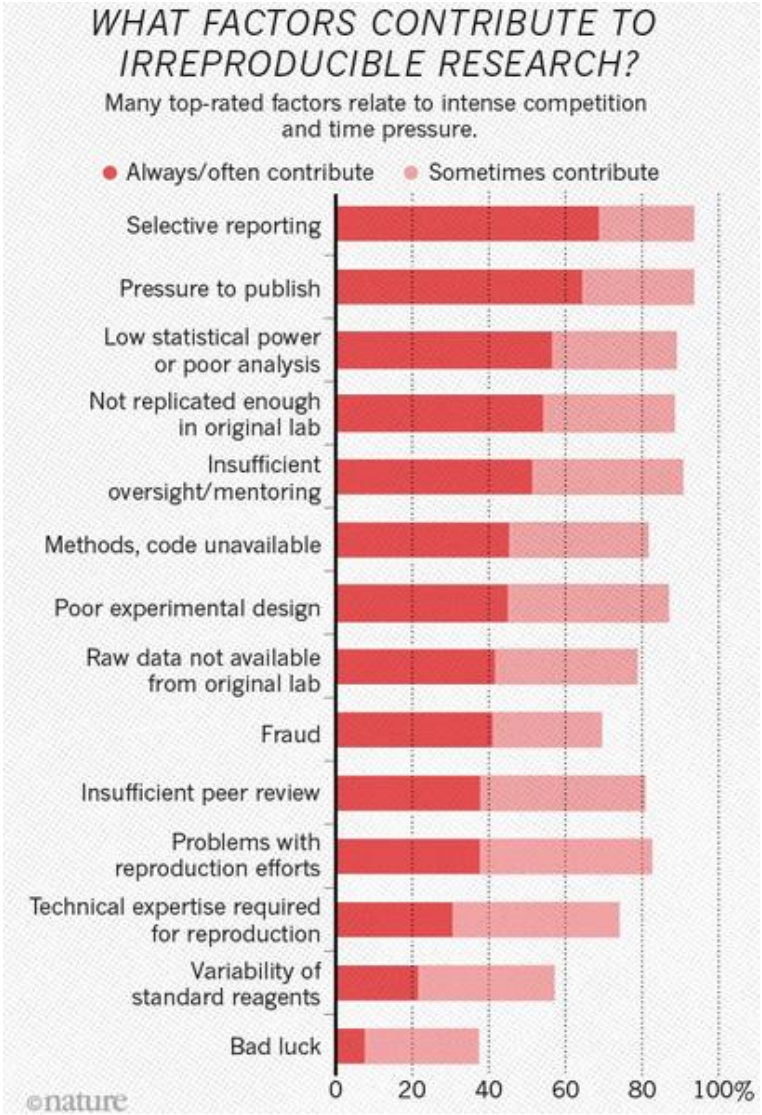
nature International weekly journal of science

- Nature conducted an online survey on reproducibility in research. 1,576 researchers took part. Results published in May 2016.
- 52% of survey respondents answered the question 'is there a reproducibility crisis?' with 'Yes, a significant crisis‘.
- 34% of respondents answered ‘no’ to the question ‘have you established procedures for reproducibility?’

Baker M. 1,500 scientists lift the lid on reproducibility. Nature. 2016;533:452–454. Accessed on 4 May 2017. http://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

Concerns about reproducibility in biomedical research (4)



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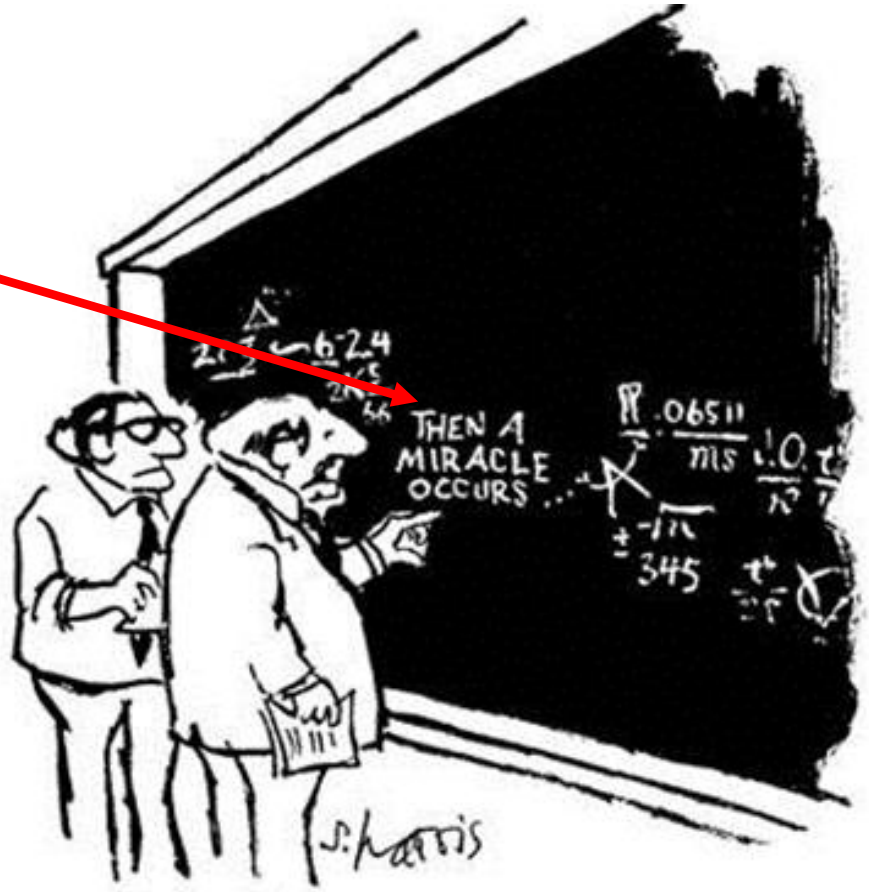
Concerns about reproducibility in biomedical research: **reporting**

- Key area of concern: research reporting
  - formal publications
  - pre-print services
  - institutional repositories
  - data sharing services

- Examples directly relating to study reproducibility include
  - incomplete reporting
  - unclear reporting
  - selective reporting
  - misleading reporting

Incomplete or unclear reporting (1)

- Hundreds of published reviews show that key elements of *methods* and *findings* are commonly missing from journal reports



"I think you should be more explicit here in step two."

from *What's so Funny About Science?* by Sidney Harris (1977

Incomplete or unclear reporting (2)

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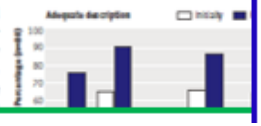
What is missing from descriptions of treatment in trials and reviews?

Replicating non-pharmacological treatments in practice depends on how well they have been described in research studies, say **Paul Glasziou** and **colleagues**

Have you ever read a trial or review and wondered exactly how to carry out treatments such as a "behavioural intervention," "salt reduction," or "exercise programme"? Although CONSORT and related ini-

receiving numerous requests for additional details from doctors and patients, the author of a randomised trial on graded exercise for chronic fatigue syndrome[5] subsequently published a supplementary article with a more



PLOS ONE

Exercise prescription: a case for standardised reporting

Clin Chem Lab Med 2012;50(3):411–413 © 2012 by Walter de Gruyter • Berlin • Boston. DOI 10.1515/cclm-2011-0904

An appeal to medical journal editors: the need for a full description of laboratory methods and specimen handling in clinical study reports

RESEARCH ARTICLE

The Devil Is in the Details: Incomplete Reporting in Preclinical Animal Research

Marc T. Avey[1,2]*, David Moher[1,3], Katrina J. Sullivan[1], Dean Fergusson[1], Gilly Griffin[1], Jeremy M. Grimshaw[1,4], Brian Hutton[1,3], Manoj M. Lalu[1,7], Malcolm Macleod[5], John Marshall[6], Shirley H. J. Mei[7], Michael Rudnicki[7], Duncan J. Stewart[7,8], Alexis F. Turgeon[9,10], Lauralyn McIntyre[1,11], Canadian Critical Care Translational Biology Gr

Adequacy of Published Oncology Randomized Controlled Trials to Provide Therapeutic Details Needed for Clinical Application

Jennifer M. Duff, Helen Leather, Edmund O. Walden, Kourtney D. LaPlant and Thomas J. George Jr

Reproducibility of Search Strategies Is Poor in Systematic Reviews Published in High-Impact Pediatrics, Cardiology and Surgery Journals: A Cross-Sectional Study

Jonathan B. Koffel, Melissa L. Rethlefsen

Published: September 26, 2016 • http://dx.doi.org/10.1371/journal.pone.0163309

Non-compliance with randomised allocation and missing outcome data in randomised controlled trials evaluating surgical interventions: a systematic review

Temitope E. Adewuyi, Graeme MacLennan and Jonathan A. Cook

BMC Research Notes 2015 8:403 | DOI: 10.1186/s13104-015-1364-9 © Adewuyi et al. 2015

Example: intervention description

Cluster RCT of 3 educational interventions to improve detection and management of dementia in primary care (BMJ 2006;332)

Educational interventions

We tested three educational interventions: an electronic tutorial on CD Rom, decision support software, and practice based workshops with a standard curriculum designed by a multidisciplinary expert group. The educational interventions reflected different approaches to adult learning: the electronic tutorial for self directed learning; decision support software for real time, real case learning; and workshops for peer reflection about real cases.

The electronic tutorial allowed for a mode of learning from case analysis, with the emphasis on reflecting on knowledge and revisiting particularly difficult and complex clinical problems. The tutorial is an "electronic book," with an indexing system that allows easy access to different themes, and hypertext links that allow the reader to move easily from one subject to another.

The decision support software was written inside the existing electronic medical record software and produces prompts for the investigation and management of dementia. This mode of learning was driven by real cases, using computer decision support software to prompt and assist clinical reasoning and care planning in real clinical time.

Two experienced general practitioners with backgrounds in postgraduate education facilitated the small group workshops with general practitioners and practice nurses. Case scenarios were discussed to illustrate appropriate management. This mode of learning involved case discussion in small, multidisciplinary groups.

Control practices were visited only to collect data. Further details about the development, format, and piloting of the interventions are reported elsewhere.[11–15]

Do you think this description is sufficient for the study to be replicated?

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Results: decision support system and workshop improve detection rates

Example: study design description

Design and setting

A prospective, randomised, double-blind controlled trial was carried out by one of the authors (KP) at Randfontein Estates Gold Mining and Westonaria Gold Mining from September 1995 to July 1996. Patients were mineworkers.

- A **double-blind randomised** trial means that the following groups were not aware of assignment to the intervention or control group:

  A. Participants and outcome assessors
  B. Participants and intervention providers
  C. Intervention providers and outcome assessors
  D. Any of the above
  E. None of the above

Example: study design description

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Example: literature search description

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Search strategy

The design, analysis, and reporting for this meta-analysis followed the MOOSE guidelines [10]. Relevant studies were identified by a literature search of the PubMed database (from January 1966 to September 1, 2016), without restrictions, using the search terms "alcohol consumption", "alcohol drinking", or "alcohol intake" combined with "stroke", or "cerebrovascular disease", or "cerebral infarction", or "intracerebral hemorrhage" or "subarachnoid hemorrhage". The database search was performed by two authors (SCL and AWa) and enhanced by searches of the reference lists of identified articles.

Is this description of the search strategy sufficient enough for the search to be reproduced confidently?

Note
(not looking at the quality or comprehensiveness of the search strategy just at whether or not the search as described could be confidently reproduced)

Example: literature search description

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No field tags given
No indication of whether Mesh headings were used
No full search strategy provided in appendix

Concerns about reproducibility in biomedical research: **methods**

- Key area of concern: research study methodology

- Examples directly relating to study reproducibility include:
  - study design
  - sample size calculations
  - statistical analysis techniques
  - experimental conditions
  - documentation/recording of study procedures/methods
  - data availability

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1974, 7, 497 NUMBER 3 (FALL 1974)

THE UNSUCCESSFUL SELF-TREATMENT OF A CASE OF "WRITER'S BLOCK"[1]

DENNIS UPPER

VETERANS ADMINISTRATION HOSPITAL, BROCKTON, MASSACHUSETTS

REFERENCES

[1]Portions of this paper were not presented at the 81st Annual American Psychological Association Convention, Montreal, Canada, August 30, 1973. Reprints may be obtained from Dennis Upper, Behavior Therapy Unit, Veterans Administration Hospital, Brockton, Massachusetts 02401.

Received 25 October 1973.
(Published without revision.)

COMMENTS BY REVIEWER A

I have studied this manuscript very carefully with lemon juice and X-rays and have not detected a single flaw in either design or writing style. I suggest it be published without revision. Clearly it is the most concise manuscript I have ever seen—yet it contains sufficient detail to allow other investigators to replicate Dr. Upper's failure. In comparison with the other manuscripts I get from you containing all that complicated detail, this one was a pleasure to examine. Surely we can find a place for this paper in the Journal—perhaps on the edge of a blank page.

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Potential impact/consequences

- Impossible for other researchers to:
  - replicate methods
  - replicate the intervention
  - reproduce findings
  - or for readers even just to understand what was done and what was found by the research study

- Research results cannot be translated into practice or used to inform future research

- Waste of the time and money invested in the research study and can be considered unethical, particularly when patients have volunteered to take part

- Consequences therefore are wide ranging and serious and can ultimately affect patient care

Current initiatives addressing research reporting and reproducibility (1)

- International campaigns and initiatives
  - REWARD Alliance (http://researchwaste.net/)
  - Lancet campaign (http://www.thelancet.com/campaigns/efficiency)
  - EQUATOR Network (http://www.equator-network.org/)
  - The Reproducibility Initiative (http://validation.scienceexchange.com/#/)
  - The Reproducibility Project: Cancer Biology (https://osf.io/e81xl/wiki/home/)
  - AllTrials (http://www.alltrials.net/)
  - Center for Open Science (https://cos.io/)
  - Global Biological Standards Institute Reproducibility 2020 action plan (https://www.gbsi.org/)
  - METRICS Institute (https://metrics.stanford.edu/)
  - NC3Rs Experimental Design Assistant (https://eda.nc3rs.org.uk/)

Current initiatives addressing research reporting and reproducibility (2)

- National initiatives
  - NIH Rigor and reproducibility (US) https://www.nih.gov/research-training/rigor-reproducibility
  - Academy of Medical Sciences Improving research reproducibility and reliability (UK) https://acmedsci.ac.uk/file-download/41615-5836c0640fd92.pdf
  - The Welcome Trust Open Research (UK) https://wellcome.ac.uk/what-we-do/our-work/open-research
- Guidelines and recommendations
  - NIH Principles and Guidelines for Reporting Preclinical Research https://www.nih.gov/research-training/rigor-reproducibility/principles-guidelines-reporting-preclinical-research
  - Center for Open Science Transparency and Openness Promotion (TOP) guidelines https://osf.io/ud578/?_ga=1.211230620.829898984.1435325845
  - FOSTER Open Reproducible Research https://www.fosteropenscience.eu/foster-taxonomy/open-reproducible-research

Proposals: Researchers

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nature human behaviour

PERSPECTIVE

PUBLISHED: 10 JANUARY 2017 | VOLUME: 1 | ARTICLE NUMBER: 0021

OPEN

A manifesto for reproducible science

Marcus R. Munafò[1,2*], Brian A. Nosek[3,4], Dorothy V. M. Bishop[5], Katherine S. Button[6], Christopher D. Chambers[7], Nathalie Percie du Sert[8], Uri Simonsohn[9], Eric-Jan Wagenmakers[10], Jennifer J. Ware[11] and John P. A. Ioannidis[12,13,14]

"Here we argue for the adoption of measures to optimize key elements of the scientific process: methods, reporting and dissemination, reproducibility, evaluation and incentives. There is some evidence from both simulations and empirical studies supporting the likely effectiveness of these measures, but their broad adoption by researchers, institutions, funders and journals will require iterative evaluation and improvement".

No publication without confirmation

"...a new type of paper for animal studies of disease therapies or preventions: one that incorporates an independent, statistically rigorous confirmation of a researcher's central hypothesis. We call this large confirmatory study a preclinical trial".

Mogil JS, MacLeod MR. No publication without confirmation. Nature. 2017;542:409-411.

Lakens *et al. BMC Psychology* (2016) 4:24
DOI 10.1186/s40359-016-0126-3

BMC Psychology

DEBATE Open Access

CrossMark

On the reproducibility of meta-analyses: six practical recommendations

Daniël Lakens[1*], Joe Hilgard[2] and Janneke Staaks[3]

Drug development: Raise standards for preclinical cancer research

C. Glenn Begley & Lee M. Ellis

Affiliations | Corresponding author

Nature **483**, 531–533 (29 March 2012) | doi:10.1038/483531a
Published online 28 March 2012

"...propose how methods, publications and incentives must change if patients are to benefit".

Proposals: Journals/Editors/Publishers (1)

Enhancing reproducibility

New reporting standards for Nature journal authors are intended to improve transparency and reproducibility.

"We will all be using a checklist (http://www.nature.com/authors/policies/checklist.pdf) intended to prompt authors to disclose technical and statistical information in their submissions and to encourage referees to consider aspects important for research reproducibility". Nature Methods. 2013;10(5):367.

Kenall *et al. Genome Biology* (2015) 16:141
DOI 10.1186/s13059-015-0710-5

Genome Biology

EDITORIAL Open Access

CrossMark

Better reporting for better research: a checklist for reproducibility

Amye Kenall[1*], Scott Edmunds[2], Laurie Goodman[2], Liz Bal[1], Louisa Flintoft[3], Daniel R Shanahan[1] and Tim Shipley[4]

jove

Peer reviewed scientific video journal
https://www.jove.com/

New article type verifies experimental reproducibility

Information Systems journal creates "Invited Reproducibility Paper"

By Hylke Koers, PhD, and Rebecca Capone Posted on 11 April 2016

Information Systems, a data science journal published by Elsevier, has devised a solution to the question of reproducibility by establishing a new article type: the Invited Reproducibility Paper.

Proposals: Journals/Editors/Publishers (2)

Editorial

Reporting reviews for publication in the Journal

Marie Crowe RN, PhD Professor[1]
and Charley Baker PhD Lecturer[2]

Version of Record online: 8 MAR 2017
DOI: 10.1111/jpm.12370
© 2017 John Wiley & Sons Ltd

Issue

"Search strategy: some reviews **fail to provide sufficient detail to enable the replication of the search** and others do not provide eligibility criteria that is linked to the review question/ objectives. The **report of the review must include details of the search strategy**, the processes used for inclusion and exclusion and a flow diagram with the details on identification, screening, eligibility and those studies included".

THE ROYAL SOCIETY PUBLISHING

Registered Reports

"A Registered Report (RR) is a form of journal article in which **methods and proposed analyses are pre-registered and peer-reviewed prior to research being conducted** (stage 1). High quality protocols are then provisionally accepted for publication before data collection commences". http://rsos.royalsocietypublishing.org/registered-reports

RESEARCH NOTE

REVISED **An Open Science Peer Review Oath**

"Here, we propose steps to help increase the transparency of the scientific method and the reproducibility of research results: specifically, we introduce a peer-review oath and accompanying manifesto. These have been designed to offer **guidelines to enable reviewers** (with the minimum friction or bias) **to follow and apply open science principles, and support the ideas of transparency, reproducibility** and ultimately greater societal impact. Introducing the oath and manifesto at the stage of peer review will help to check that the research being published includes everything that other researchers would need to successfully repeat the work". https://f1000research.com/articles/3-271/v2

Proposals: Funders

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NHS National Institute for Health Research

Journals Library

The NIHR is the world's first health research funder to publish comprehensive accounts of its commissioned research within its own publicly and permanently available journals. The NIHR Journals Library comprises a suite of five open access peer-reviewed journals reporting results from a range of health research areas.

It aims to increase the impact of NIHR research, so that evidence is shared more effectively with the NHS and wider public health landscape. It also improves access to the full story of our research projects, to ensure that they can be more easily reproduced and that there is a transparent record of the research carried out. To achieve this, all project information appears in one location alongside the journal report, its summaries and other content produced as part of the project, such as articles published in other journals and research data.

MRC Medical Research Council

Reproducibility in science — where the MRC comes in

by Guest Author on 29 October 2015

*The MRC and a group of partner organisations have today published a report and joint statement about the reproducibility and reliability of research, and what can be done to improve them. Here, **Jim Smith**, MRC Deputy*

wellcome

Funding

Improving the reproducibility of research

One element of good research practice is reproducibility. To develop and implement ways to improve the reproducibility of biomedical research, we've partnered with the:

- Academy of Medical Sciences
- Biotechnology and Biological Sciences Research Council
- Medical Research Council.

NIH National Institutes of Health | Office of Extramural Research

Grants & Funding | NIH's Central Resource for Grants

Guidance: Rigor and Reproducibility in Grant Applications

The NIH is committed to promoting rigorous and transparent research in all areas of science supported by a variety of grant programs. Updates to application instructions and review language intended to enhance reproducibility through rigor and transparency have been implemented for research grants and mentored career development awards. Updates to institutional training grants, institutional career development awards (K12/KL2) and individual fellowships will be forthcoming in 2017 or later.

Suggested solutions: overview

- Study registration
- Protocol publication
- Research training: study design and methods
- Study documentation/recording
- Reporting guidelines and checklists
- New article publication types
- Alternative publication formats
- Culture change in research institutions
- Changes to accessibility and research dissemination
- Changes in incentivisation
- Awareness raising

Biomedical librarians and research reproducibility

- The scientific research process should be highly rigorous to ensure that findings are reliable
- As librarians we aim to support biomedical researchers in designing, conducting and publishing research of the highest standard possible
- In terms of **research reproducibility** as **librarians** we can help to address the **reporting** aspects of reproducibility and to a certain extent **methodological** aspects
- We can use our skills to encourage, support and increase rigor in biomedical research

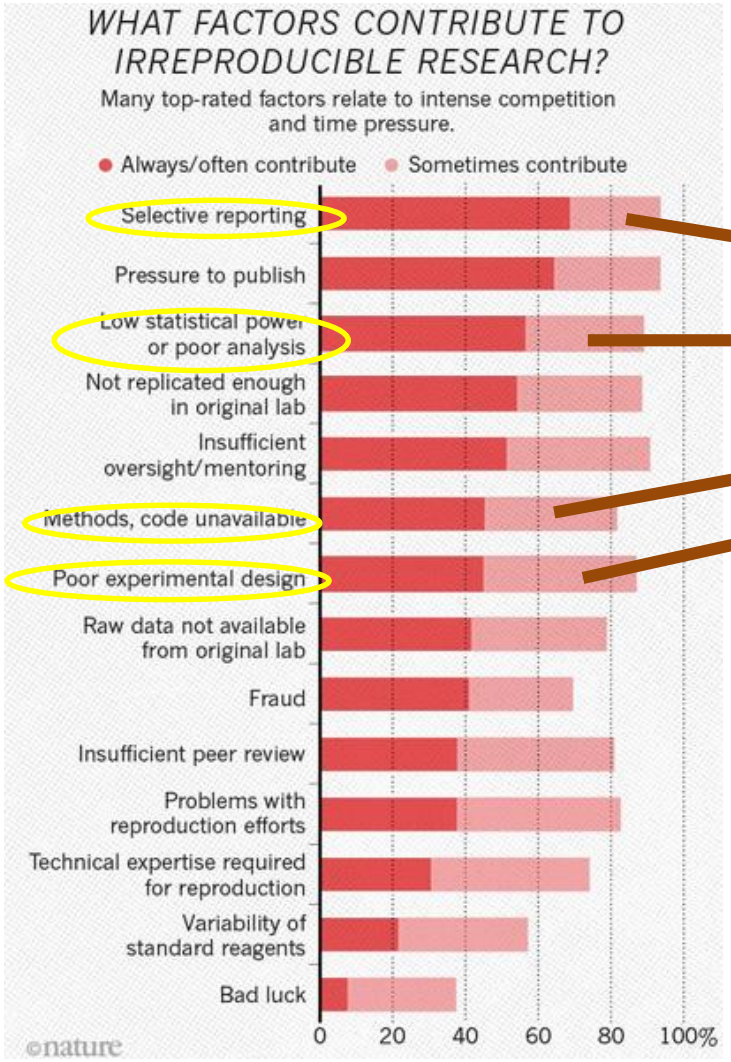
Research reproducibility in the biomedical sciences is crucial in establishing the robustness and reliability of the research results which ultimately benefits patients

So how can librarians help? (1)

- Daily contact with biomedical researchers
- Used to identifying and delivering new services in response to changing demands
- Used to liaising with range of departments and faculty in our institutions
- Work in a diverse range of roles with many opportunities for awareness raising and engagement

Some simple actions targeting widely documented reporting and reproducibility issues could go a long way to helping to address this serious global problem

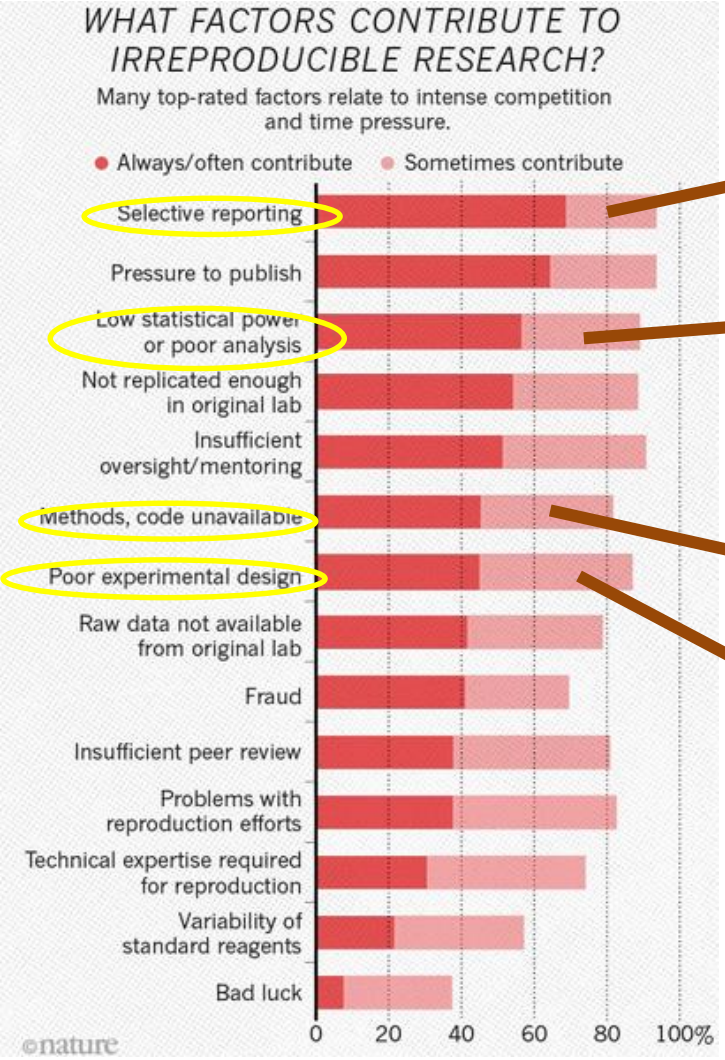
So how can librarians help? (2)



Librarians can help to directly address these issues

Baker M. 1,500 scientists lift the lid on reproducibility. Nature. 2016;533:452–454. Accessed on 4 May 2017. http://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

So how can librarians help? Examples (3)



Raise awareness of available reporting guidelines

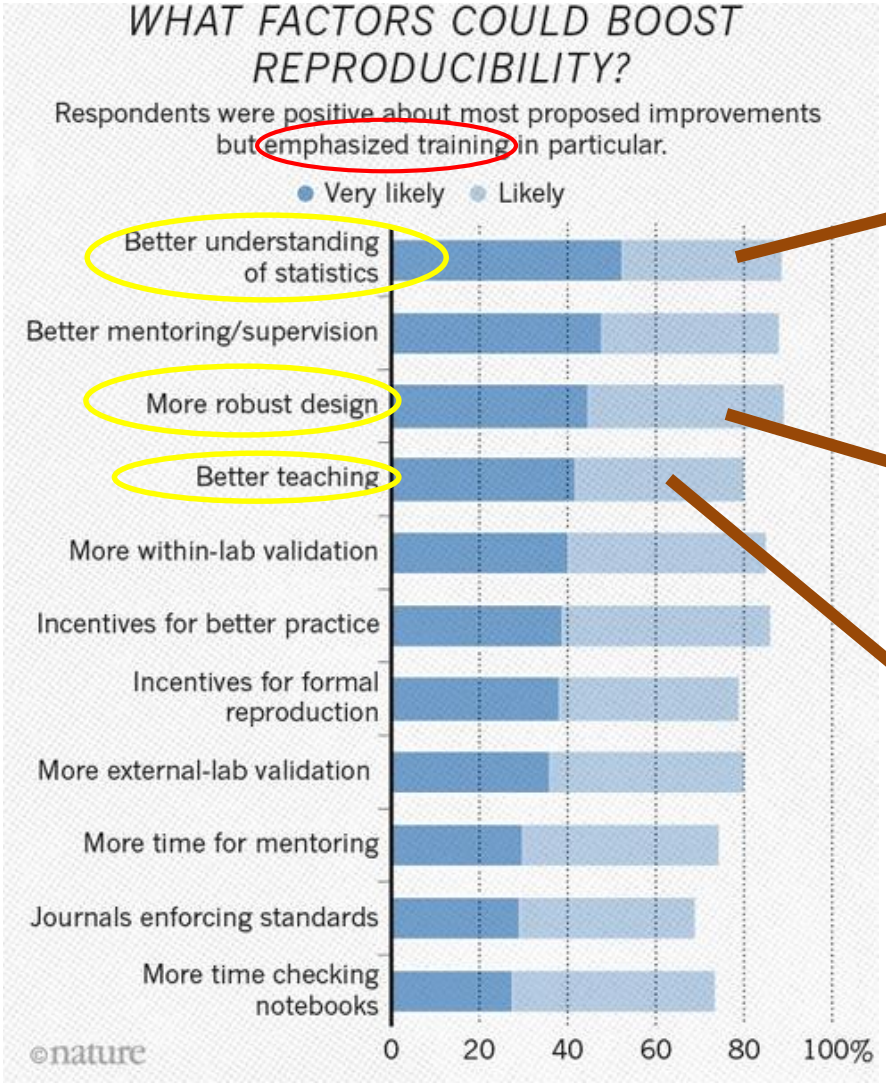
Sign-post researchers to locally available statistical support

Raise awareness of the importance of and initiatives encouraging open science and data sharing

Sign-post researchers to locally available study design support

Baker M. 1,500 scientists lift the lid on reproducibility. Nature. 2016;533:452–454. Accessed on 4 May 2017. http://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

So how can librarians help? Examples (4)



Highlight key statistical resources and online training and advise on local statistical support

Highlight key study design resources and online training and advise on local research support services

Work with faculty to encourage/provide research design, conduct, reporting and statistical training sessions

Baker M. 1,500 scientists lift the lid on reproducibility. Nature. 2016;533:452–454. Accessed on 4 May 2017. http://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

So how can librarians help: **Methods**

Opportunities for us to help to address methodological aspects of reproducibility such as:

- promote the importance of documentation/recording of study methods e.g. experimental methods written up in lab notebooks
- raise awareness of available guidance/resources for designing research studies
- promote resources/guidance on statistical methods and analysis techniques
- encourage researchers to seek local expert help in research design and to consult with local statisticians
- advise researchers on available data management, data sharing and data storage procedures and guidelines

Generally raise awareness of documented methodological issues in research studies and encourage researchers to think about reproducibility at all stages during the research process.

So how can librarians help: **Reporting**

- Many more opportunities for us to help to address reporting aspects of reproducibility such as:
  - raising awareness amongst researchers about reporting problems including selective, unclear, misleading or incomplete reporting and highlighting the consequences
  - encouraging researchers to report their study fully including a full description of the intervention(s), statistical analysis, study design etc.
  - highlighting the importance of ensuring the results from all research studies undertaken are accessible (many studies never publish/report their results)
  - encouraging study registration and the development and public availability of study protocols
  - raising awareness of and promoting the use of reporting guidelines for writing up research studies

'Reporting' is most often associated with formally published reports of research but transparent and accurate reporting is just as important when making research study reports available on organisational websites, article pre-print services, institutional repositories etc. and also when sharing research data and methods.

Reporting guidelines

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- Statements that provide advice on how to report research methods and findings
- Specify a minimum set of items required for a clear and transparent account of what was done and what was found in a research study
- Typically take the form of a checklist, flow diagram or piece of explicit text
- Based on available evidence and reflect the consensus opinion of experts in a particular field
- Complement advice on scientific writing and journals' instructions to authors
- Some examples include:

CONSORT
CONSORT
TRANSPARENT REPORTING of TRIALS

PRISMA
PRISMA
TRANSPARENT REPORTING of SYSTEMATIC REVIEWS and META-ANALYSES

STROBE Statement
Strengthening the reporting of observational studies in epidemiology

Example reporting guideline checklists

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CONSORT Statement extension for reporting abstracts of randomized controlled trials

This extension to the CONSORT Statement provides a minimum list of essential items, that authors should consider when reporting the main results of a randomized trial in any journal or conference abstract.

CONSORT for Abstract Checklist **www.consort-statement.org**

Item	Description
Title	Identification of the study as randomized
Authors *	Contact details for the corresponding author
Trial design	Description of the trial design (e.g. parallel, cluster, non-inferiority)
Methods	
Participants	Eligibility criteria for participants and the settings where the data were collected
Interventions	Interventions intended for each group
Objective	Specific objective or hypothesis
Outcome	Clearly defined primary outcome for this report
Randomization	How participants were allocated to interventions
Blinding (masking)	Whether or not participants, care givers, and those assessing the outcomes were blinded to group assignment
Results	
Numbers randomized	Number of participants randomized to each group
Recruitment	Trial status
Numbers analysed	Number of participants analysed in each group
Outcome	For the primary outcome, a result for each group and the estimated effect size and its precision
Harms	Important adverse events or side effects
Conclusions	General interpretation of the results
Trial registration	Registration number and name of trial register
Funding	Source of funding

PRISMA Statement 2009 – Reporting guideline for systematic reviews and meta-analyses

PRISMA stands for Preferred Reporting Items for Systematic reviews and Meta-Analyses. It is an evidence-based minimum set of standards for reporting systematic reviews and meta-analyses. It consists of a 27-item checklist and a flow diagram which depicts the flow of information through the different phases of a systematic review.

This guideline replaces the existing QUOROM Statement; journals and other organisations are encouraged to update their instructions and resources and refer authors to the new PRISMA guidance.

PRISMA 2009 Checklist **www.prisma-statement.org**

Section / topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	

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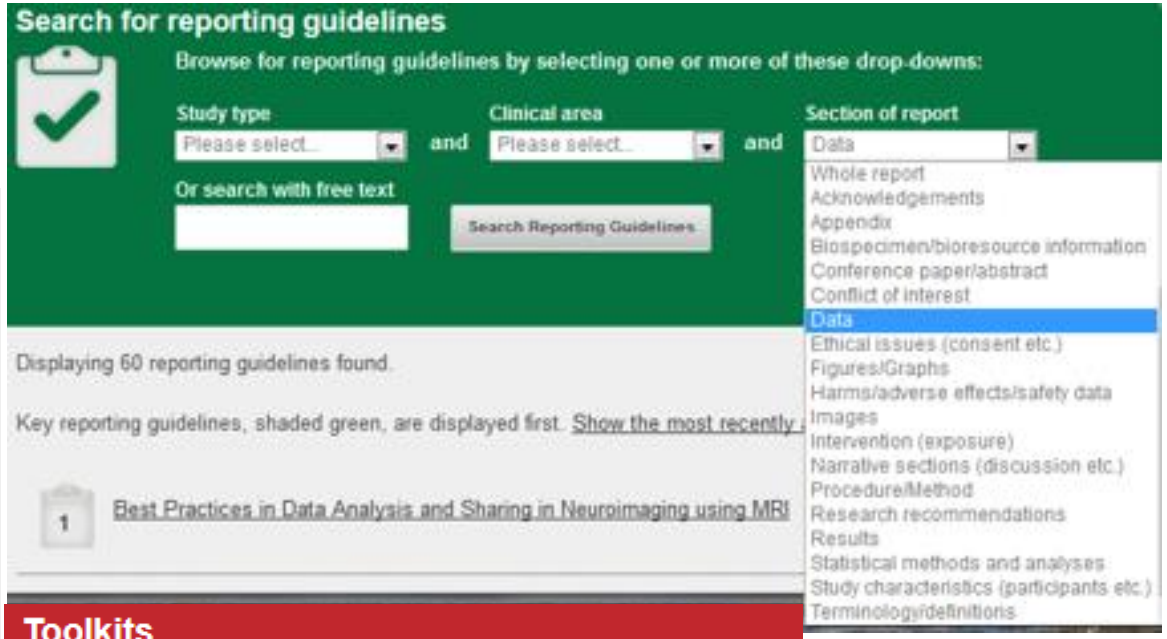
Reporting guidelines for main study types

Randomised trials	CONSORT	Extensions	Other
Observational studies	STROBE	Extensions	Other
Systematic reviews	PRISMA	Extensions	Other
Case reports	CARE	Extensions	Other
Qualitative research	SRQR	COREQ	Other
Diagnostic / prognostic studies	STARD	TRIPOD	Other
Quality improvement studies	SQUIRE		Other
Economic evaluations	CHEERS		Other
Animal pre-clinical studies	ARRIVE		Other
Study protocols	SPIRIT	PRISMA-P	Other
Clinical practice guidelines	AGREE	RIGHT	Other

See all 359 reporting guidelines



Toolkits

This section provides practical help and resources to support you in:

- Writing research
- Using guidelines in your journal
- Teaching research skills
- Selecting the appropriate reporting guideline

Librarian action plan: simple ideas (1)

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Librarian Action Plan

Librarians have an essential role to play in addressing biomedical research reporting and reproducibility issues: a call to action

Serious concerns have been raised about the robustness of biomedical research studies and their resultant publications.

Potential solutions and recommendations have been much discussed, including in the Lancet Waste Series[1] and in the Manifesto for Reproducible Science[2].

At the EQUATOR Network[3] we believe that **biomedical librarians have a key role to play in helping to address these fundamental concerns.**

What impact could my library have?

Biomedical librarians are excellently placed to raise awareness of and target new services towards helping to address research reporting and reproducibility issues amongst their clinicians/researchers/faculty. By taking some simple actions now librarians can contribute to raising biomedical research standards and publication quality. The resultant higher impact research outputs raise the profile and reputation of institutions, with librarians being seen to have directly contributed to this.

Who should I work with?

Involve key people from your institution/organisation: Faculty; Deans; Departmental Heads; Research Clinicians.
Approach departments: Research Services; Writing Centre; Grants Office, Scholarly Communications Office.
Discuss and share ideas with other biomedical librarians!

Action plan

Some simple ideas to get you started!

Promotion

* Add/share hyperlinks to initiatives for example the EQUATOR Network, METRICS, COMET, Centre for Open Science, NIH Rigor and Reproducibility to library websites, Libguides or social media.
* Raise awareness of reporting guidelines, reproducibility standards, data sharing resources, open access, research study registers in library bulletins and current awareness services.
* Highlight reporting and reproducibility issues in library leaflets and posters.

Training

* Where relevant add in a few additional slides about reporting guidelines, research reproducibility, research protocols, research study registers, data sharing, open access etc. to existing training sessions/workshops.
* Work with faculty to incorporate training on reporting guidelines and reproducibility into existing courses.

Researcher Support

* When providing the results of literature searches to clinicians/researchers advise them on the correct reporting guideline to use to write up their study for publication.
* Discuss current research reporting and reproducibility issues with clinicians/researchers and make sure that they are aware of where they can obtain help in designing, conducting and reporting their research.

References

1. Research: increasing value, reducing waste, The Lancet Series. http://www.thelancet.com/series/research
2. Munafò MR et al. A manifesto for reproducible science. Nature Human Behaviour.2017;0021. https://www.nature.com/articles/s41562-016-0021
3. The EQUATOR Network http://www.equator-network.org/
The EQUATOR Librarian Network http://www.equator-network.org/librarians/

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EQUATOR Knowledge and Information Manager
shona.kirtley@csm.ox.ac.uk

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Librarian action plan: simple ideas (2)

- Promotion
  - Link to initiatives e.g. EQUATOR Network, Centre for Open Science, NIH Rigor and Reproducibility from library websites, Libguides or social media.
  - Raise awareness of reporting guidelines, reproducibility standards, data sharing resources, research study registers in library bulletins or current awareness services.
- Training
  - Add in additional slides about reporting guidelines, research reproducibility, research protocols, study registers, data sharing, open access etc. to existing training sessions/workshops.
  - Work with faculty to incorporate training on reporting guidelines and reproducibility into existing courses.
- Researcher support
  - Advise clinicians/researchers on the correct reporting guideline to use to write up their study for publication.
  - Discuss current research reporting and reproducibility issues with clinicians/researchers and make sure they are aware of where to obtain help with designing, conducting and reporting their research.

Librarian targeted action plan (1)

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Librarians have an essential role to play in addressing biomedical research reporting and reproducibility issues
Can you help?

Serious concerns have been raised about the robustness of biomedical research studies and their resultant publications.

Potential solutions and recommendations have been much discussed, including in the Lancet Waste Series[1] and in the Manifesto for Reproducible Science[2].

At the EQUATOR Network[3] we believe that **biomedical librarians have a key role to play in helping to address these fundamental concerns.**

Take action to support the Lancet Waste Series and the Manifesto for Reproducible Science Ideas for targeted library actions	Action supports Lancet Waste Series	Action supports Manifesto for Reproducible Science
Research protocols * Highlight the importance of protocols, guidelines for writing protocols (e.g. SPIRIT) and encourage researchers to make their protocols publicly accessible. ***Suggested actions*** ***Promotion:*** highlight and link to guidelines and initiatives on library websites, Libguides, leaflets, bulletins, social media. ***Training:*** hold/incorporate into existing workshop/training session. ***Researcher support:*** mention to researchers/faculty during consultations. * Help researchers to identify ongoing studies investigating the same or a similar research topic to avoid duplication. ***Suggested actions*** ***Researcher support:*** establish a literature search service specifically targeting development of study protocols or analysis plans.	✓ ✓	
Research study registration * Promote research study registers for example for clinical trials (e.g. clinicaltrials.gov) or systematic reviews (e.g. PROSPERO), the benefits of registering studies, and the requirements for reporting on study completion. ***Suggested actions*** ***Promotion:*** highlight and link to guidelines and initiatives on library websites, Libguides, leaflets, bulletins, social media. ***Training:*** hold/incorporate into existing workshop/training session. ***Researcher support:*** mention to researchers/faculty during consultations; insist on study registration before providing help with literature searches.	✓	✓
Research design and conduct * Highlight resources supporting research study design, standards for conducting research and research ethics, including guidance and courses (e.g. IRB, NIH). ***Suggested actions*** ***Promotion:*** handouts; include links on library website, bulletins, on social media, Libguide. ***Researcher support:*** discuss with researchers during consultations. ***Training:*** initiate joint workshop with the local Research Ethics Committee or Research Services Department. * Support training in statistics and research methods ***Suggested actions*** ***Promotion:*** prepare handouts; Libguide. ***Training:*** work with faculty to organise specific joint workshops/training sessions. ***Researcher support:*** provide/sign post to research methods support; discuss with researchers/faculty during consultations.	✓	✓

Librarian targeted action plan (2)

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Research reporting * Promote reporting guidelines (e.g. CONSORT, PRISMA, STROBE), how to find them and how they can be easily used for planning and writing research papers. ***Suggested actions*** ***Promotion:*** new leaflet/poster; Libguide; inclusion of hyperlinks on library website, in bulletins, social media. ***Training:*** hold reporting/publication workshops; work with faculty to ensure that reporting guidelines are included in course content. ***Researcher support:*** mention to researchers/faculty during consultations; when providing the results of literature searches advise researchers on the appropriate reporting guideline to use to write up their study; work with institutional Writing Centres/Scholarly Communications Managers to raise awareness.	✓	✓
Literature searching * Promote involvement of methodologists, including librarians, in the planning and design of proposed studies (lit search, documentation and reporting). ***Suggested actions*** ***Researcher support:*** work with faculty and Research Services/Grants Offices to promote the involvement of and demonstrate the value of librarians being involved in the research team from study inception and the range of support they can provide to researchers and Research Services Departments.		✓
* Promote librarian-led identification of existing evidence in support of grant applications and before new research is instigated (ensuring new research addresses uncertainties rather than duplicating previous work). ***Suggested actions*** ***Researcher support:*** work with faculty and Research Services/Grants Offices to support grant applications and the planning and design of proposed studies.	✓	✓
Supporting systematic reviews * Encourage researchers to obtain the protocols (if available) for included studies to check the protocol corresponds to the content of the published paper. ***Suggested actions*** ***Training:*** workshop/training session. ***Researcher support:*** mention to researchers/faculty during consultations.	✓	
Open access / institutional repositories / scholarly communication * Recommend open access journals to researchers and provide advice on open data initiatives, software etc. ***Suggested actions*** ***Promotion:*** Libguide; add links to website, bulletins, social media. ***Training:*** hold joint workshop with Research Data/Scholarly Communications Manager. ***Researcher support:*** highlight to researchers/faculty during consultations.	✓	✓
* Advocate the registering, archiving and deposit of final research reports (and unpublished research materials) in online institutional repositories. ***Suggested actions*** ***Promotion:*** posters; Libguide; links in bulletins, social media. ***Researcher support:*** work with institutional Research Data/Scholarly Communications Teams.	✓	
* Highlight the issue of retractions as researchers are often unaware of retraction notices posted on publisher websites or in bibliographic databases. ***Suggested actions*** ***Promotion:*** launch a current awareness service specifically highlighting retracted papers.	✓	
* Promote the role of initiatives such as PubMed Commons in driving up research standards, including the reporting and reproducibility of literature searches. ***Suggested actions*** ***Training:*** include in workshop/training session. ***Researcher support:*** discuss with researchers/faculty during consultations.		✓

References

1. Research: increasing value, reducing waste, The Lancet Series. http://www.thelancet.com/series/research
2. Munafò MR et al. A manifesto for reproducible science. Nature Human Behaviour.2017;0021. https://www.nature.com/articles/s41562-016-0021
3. The EQUATOR Network http://www.equator-network.org/
The EQUATOR Librarian Network http://www.equator-network.org/librarians/

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Librarian targeted action plan (3)

Targeted Action Plan takes key recommendations from the Lancet Waste Series and the Manifesto for Reproducible Science and provides suggested actions that librarians could take to respond directly to each set of recommendations.

Some example actions include:

Research protocols

* Highlight the importance of protocols, guidelines for writing protocols (e.g. SPIRIT) and encourage researchers to make their protocols publicly accessible.

Suggested actions

Promotion: highlight and link to guidelines and initiatives on library websites, Libguides, leaflets, bulletins, social media.

Training: hold/incorporate into existing workshop/training session. ***Researcher support:*** mention to researchers/faculty during consultations.

Research study registration

* Promote research study registers for example for clinical trials (e.g. clinicaltrials.gov) or systematic reviews (e.g. PROSPERO), the benefits of registering studies, and the requirements for reporting on study completion.

Suggested actions

Promotion: highlight and link to guidelines and initiatives on library websites, Libguides, leaflets, bulletins, social media.

Training: hold/incorporate into existing workshop/training session.

Researcher support: mention to researchers/faculty during consultations; insist on study registration before providing help with literature searches.

Librarian targeted action plan (4)

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Some example actions (cont.)

Research design and conduct

* Highlight resources supporting research study design, standards for conducting research and research ethics, including guidance and courses (e.g. IRB, NIH).

Suggested actions

Promotion: handouts; include links on library website, bulletins, on social media, Libguide. ***Researcher support:*** discuss with researchers during consultations.

Training: initiate joint workshop with the local Research Ethics Committee or Research Services Department.

Research reporting

* Promote reporting guidelines (e.g. CONSORT, PRISMA, STROBE), how to find them and how they can be easily used for planning and writing research papers.

Suggested actions

Promotion: new leaflet/poster; Libguide; inclusion of hyperlinks on library website, in bulletins, social media.

Training: hold reporting/publication workshops; work with faculty to ensure that reporting guidelines are included in course content.

Researcher support: mention to researchers/faculty during consultations; when providing the results of literature searches advise researchers on the appropriate reporting guideline to use to write up their study; work with institutional Writing Centres/Scholarly Communications Managers to raise awareness.

* Promote librarian-led identification of existing evidence in support of grant applications and before new research is instigated (ensuring new research addresses uncertainties rather than duplicating previous work).

Suggested actions

Researcher support: work with faculty and Research Services/Grants Offices to support grant applications and the planning and design of proposed studies.

Role-specific action examples

- Research Data Librarian or Open Access Librarian

* Recommend open access journals to researchers and provide advice on open data initiatives, software etc.

Suggested actions

Promotion: Libguide; add links to website, bulletins, social media. ***Training:*** hold joint workshop with Research Data/Scholarly Communications Manager.

Researcher support: highlight to researchers/faculty during consultations.

- Scholarly Communications Manager/Librarian

* Highlight the issue of retractions as researchers are often unaware of retraction notices posted on publisher websites or in bibliographic databases.

Suggested actions

Promotion: launch a current awareness service specifically highlighting retracted papers.

- Institutional Repository Manager/Librarian

* Advocate the registering, archiving and deposit of final research reports (and unpublished research materials) in online institutional repositories.

Suggested actions

Promotion: posters; Libguide; links in bulletins, social media. ***Researcher support:*** work with institutional Research Data/Scholarly Communications Teams.

Discussion

- Discussion: 5-10 minutes
- Have you got ideas for how you could help address research reproducibility in your library? Have you already introduced new services/resources in your library?
- Time to swap ideas and share experiences
- Short time afterwards for feeding back some ideas

Summing up

From discussions:

Identified that we have a role to play

Identified some actions that we could take back to our libraries

- **Ensure** that we keep up-to-date with concerns being raised within the biomedical research community
- **Proactively** identify opportunities where we can expand our services to respond to concerns
- **Involve** key people from your institution/organisation: Faculty; Deans; Departmental Heads; Research Clinicians.
- **Approach** departments: Research Services; Writing Centre; Grants Office, Scholarly Communications Office.
- **Discuss** and share ideas and experiences with other biomedical librarians

What impact could my library have?

- You can demonstrate that your library is:
  - introducing new services in the context of responding to important international concerns documented in the medical literature
  - collaborating widely across the institution including with faculty, and staff in departments such as Research Services, Funding/Grants Offices, Academic Writing Centres, Scholarly Communications Offices
  - playing a fundamental role in improving the rigour, completeness, transparency, quality and reproducibility of the biomedical research output of your institution/organisation
  - contributing to raising the profile and reputation of your institution as a result of improved higher impact research output

Ultimately you will raise the profile of your library and reassure clinicians, researchers and institutional/organisational management that the library, its staff and the services provided are proactive, up-to-date and focussed on addressing real need.

As a librarian you will be directly and positively impacting the quality, reliability and usability of future biomedical research.

Key messages

- Reproducible research is achievable
- Librarians have not been explicitly acknowledged as stakeholders - it is up to us to raise our voices and show that we can meaningfully contribute to global efforts to address reporting and reproducibility issues
- Take the lead in raising awareness of the issues and promoting available solutions
- Encourage scientists to change their practice by providing enhanced research support services
- Work with scientists and faculty at our institutions to expand the teaching curriculum

Biomedical librarians do have an important role to play in addressing concerns about reporting and reproducibility issues and we can make a real difference.

Expanding library services directly in response to widely documented concerns in medical research will raise the profile of the library and will be well received by your institutions and organisations.

Veldkamp LS, Hartgerink CHJ, van Assen MALM, Wicherts JM. Who Believes in the Storybook Image of the Scientist?, Accountability in Research. 2017;24:3, 127-151, DOI: 10.1080/08989621.2016.1268922

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"Just like any other professional endeavour involving human beings, science is prone to human error and bias…Not only scientists themselves, but science policy makers, science funders, academic institutes and scientific publishers should all actively strive together for a 'scientific utopia': a transparent, reproducible science system in which there is room for correction of error…It is time to step off our pedestal, accept our humanness, and collaborate to create an open research culture that acknowledges but at the same time addresses our fallibility".

+ Biomedical librarians!

Take action now – we can make a difference!

EQUATOR Network

Steering group

UK EQUATOR Centre

Acknowledgements

Many thanks to Dr Iveta Simera for permission to reproduce some slides and for helpful comments on this presentation.

Thank You

Action Plans can be freely downloaded from our website.

Please feel free to contact me with any questions or suggestions!

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Librarian Network

http://www.equator-network.org/librarians/