GUIDELINE

for SOCIALLY RESPONSIBLE (BIO)MEDICAL RESEARCH

GUIDING QUESTIONS FOR DESIGNING & CONDUCTING SOCIALLY RESPONSIBLE (BIO)MEDICAL RESEARCH
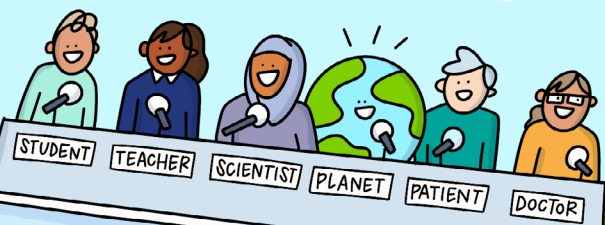
INCREASE your GREEN HANDSHAKE

DECREASE your FOOTPRINT

the **RESEARCH CYCLE**

PROBLEM ANALYSIS

RESEARCH PLAN

EXECUTION

RESULTS

CONCLUSION & DISCUSSION

REPORTING & DISSEMINATION

INCLUSION of STAKEHOLDERS DURING the RESEARCH CYCLE!

STUDENT | TEACHER | SCIENTIST | PLANET | PATIENT | DOCTOR

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de CO2-assistent

UMC Utrecht

PLANETARY HEALTH INTEGRATION TEAM

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Introduction

This document is written primarily for students and teachers but is relevant to anyone involved in (bio)medical research. Using guiding questions, the reader is invited to reflect on his, her or their societal responsibility and apply this in thinking, acting and writing. This is done using the stages of the research cycle (depicted on the front page of this guideline).

Guideline learning goals

After reviewing this handout, the reader will be able to:

1 Explain the importance of engaging in socially responsible (bio)medical research from a planetary health perspective. This should ensure participation of relevant stakeholders, environmental sustainability, and equity.

2 Apply the presented concepts in writing a research proposal, conducting research, and reporting and disseminating findings.

3 Evaluate the extent to which societal responsibility is considered in existing studies and research proposals.

Key concepts

Socially responsible research: Research that is relevant, well-designed, ethical, sustainable, and focused on (future) practical application. A key aspect is active participation and inclusion of relevant community stakeholders during all phases of the research process, thereby incorporating a variety of stakeholder needs, desires and perspectives. The ultimate goal is to minimise the ecological footprint (negative environmental impact) and maximise the 'green handshake' (positive impact on people, animals and the natural environment).

Diversity: Acknowledging, respecting and valuing differences between people.[1]

Inclusion: Creating a community and environment where everyone feels at home and valued.[1]

Equity: Creating equal opportunities for all, based on the understanding that people do not have an equal starting position. Sometimes additional support is needed to achieve equal opportunities, taking into account both visible barriers (e.g. physical limitations) and invisible barriers (e.g. cultural aspects, literacy).[2]

Planetary health: A solution-oriented, transdisciplinary field and social movement focused on better understanding the relationships between human health and the environment. The interconnectedness of human, plant and animal health and well-being as well as social justice are key. It seeks a new paradigm in which humans behave as part of the planetary ecosystem, rather than dominating it. Core values include compassion, cooperation and gratitude. (Definition of Planetary Impulse Team UMC Utrecht, based on various sources.)[3,4]

Ecological sustainability: Preserving and protecting natural systems, in which organisms and their environment can continue to exist. This includes meeting the needs of current generations ('here and now') without compromising the ability of people in other places ('elsewhere') and future generations ('later') to meet their needs.[5]

Evidence-based research: Using existing scientific evidence in a systematic and transparent way when preparing a new study. The selected research question is relevant and worthwhile, and answered in a valid and efficient manner (**Box 1**).[6]

Open Science: An international movement to make scientific research accessible to all, benefiting both scientists and society. Open Science also ensures that knowledge is obtained in an inclusive, equitable and sustainable way (**Box 5**).[7]

Multidisciplinary research: Investigating the same issue independently from multiple different academic disciplines. The acquired knowledge is eventually presented to each other and jointly reported to the outside world.[8] Think of a review with different 'chapters' for each discipline.

Interdisciplinary research: Jointly investigating the same issue from different academic disciplines. The acquired knowledge is linked together.[8]

Transdisciplinary research: Jointly investigating a complex societal issue with different academic disciplines as well as societal stakeholders. The knowledge is acquired together and is thus automatically linked (the boundaries between disciplines blur). A transdisciplinary study regards the problem more as a whole than a multi- or interdisciplinary research and is solution-oriented.[8]

LEGEND
- 💡 GOAL / RESEARCH QUESTION
- 🔵 DISCIPLINE
- ⭐ STAKEHOLDER PARTICIPANT
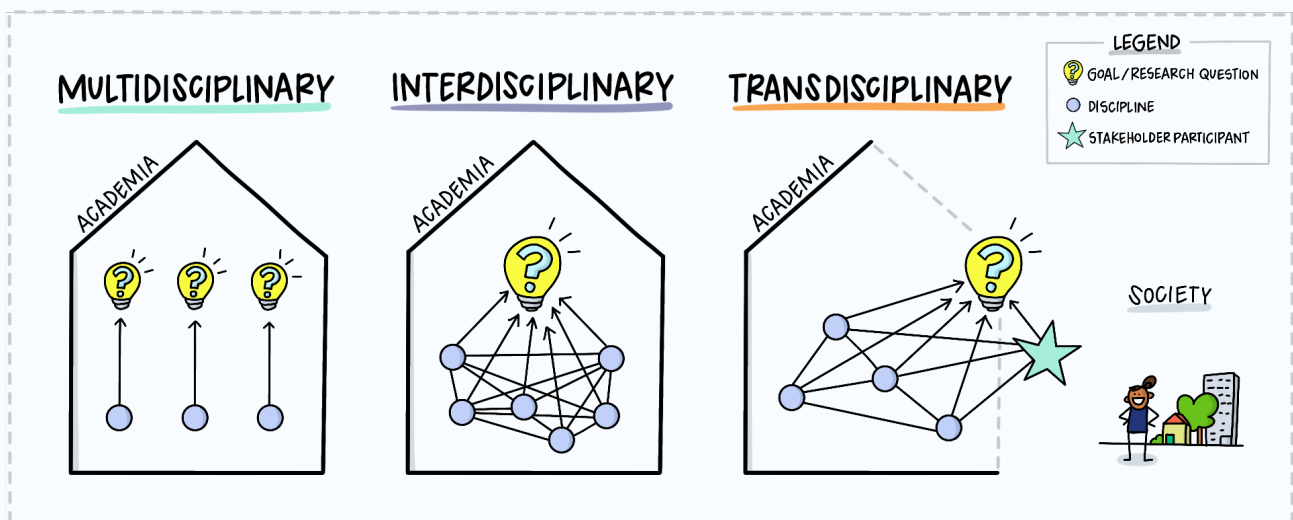
Checklist

	Component	Paragraph	Space for explanation
	1. Problem analysis		
☐	Has sufficient preliminary research been done to avoid research waste?	**§1.1**	
☐	Is there a clear societal need for this study?	**§1.2** **§1.3**	
☐	Are relevant stakeholders involved in drafting the research question?	**§1.4**	
☐	Have (un)desired side effects been considered?	**§1.5** **§1.6**	
	2. Research plan		
	Research team		
☐	Has one's own positionality within the study been considered?	**§2.1**	
☐	Is the composition of the research team diverse and are different relevant perspectives included?	**§2.2**	
☐	Is communication within the research team inclusive and understandable?	**§2.3**	
	Methodology		
☐	Is the chosen methodology or (lab) technique the most appropriate, efficient, and effective?	**§2.4**	
☐	Are relevant stakeholders involved in designing and conducting the study?	**§2.5**	
☐	Are potential sources of bias minimised as much as possible?	**§2.6**	
☐	Is pre-registration of research design appropriate to encourage transparency and collaboration?	**§2.7**	
	Participants		
☐	Is the sample composition representative and inclusive?	**§2.8** **§2.9**	
	Variables and analysis		
☐	Are appropriate baseline variables chosen to capture relevant diversity characteristics?	**§2.10**	
☐	Are the predictor and outcome variables relevant to (clinical) practice?	**§2.11**	

Have relevant subgroup analyses been carefully considered?	§2.12	
What will be done with any experiential knowledge collected?	§2.13	
Means		
Has laboratory animal use been replaced, reduced or refined?	§2.14 §2.15	
Has money been set aside for preliminary research and dissemination?	§2.16	
By whom are the costs of the research paid (indirectly) and have they been minimised?	§2.17	

3. Execution

Participants		
Has accessibility for marginalised groups been taken into account during recruitment and participation?	§3.1	
Is communication with participants comprehensive, inclusive and understandable?	§3.2	
Means		
Has the ecological footprint been minimised as much as possible?	§3.3 §3.4	
Are (laboratory) experiments carefully prepared and efficiently conducted?	§3.5	
Has data management been applied according to Green and FAIR principles?	§3.6	

4. Results

Are the results presented and written down in an inclusive manner?	§4.1 - §4.3	
Are relevant stakeholders involved in the interpretation of the results?	§4.4	
Have all null findings been reported?	§4.5	
Are negative side effects taken into account in the interpretation of the results?	§4.6	

5. Conclusion & Discussion

Do the results support the drawn conclusions?	§5.1	
Have the references been chosen objectively?	§5.2	

☐	Has the context and generalisability of results been considered?	**§5.3**	
☐	To what extent can the results be implemented in practice?	**§5.4**	
☐	Are the recommendations for follow-up research necessary and societally relevant?	**§5.5** **§5.6**	

6. Reporting & Dissemination

General

☐	Have relevant reporting guidelines been used?	**§6.1**	
☐	Is reporting and dissemination digital whenever possible?	**§6.2**	
☐	Are meetings and conferences attended digitally/hybrid whenever possible?	**§6.3**	
☐	Are the correct people listed as authors and/or in the acknowledgments?	**§6.4**	

Scientific community

☐	Are the findings published as a preprint?	**§6.5**	
☐	Are the findings and supplementary information published open access?	**§6.6** **§6.7**	

Society

☐	Are disseminated research findings comprehensible and accessible to both stakeholders and the broader public?	**§6.8 - §6.12**	

7. Evaluation

☐	Has the societal and scientific value of the study been carefully evaluated after completion?	**§7.1**	
☐	Has the practical implementation of the findings been properly considered?	**§7.2**	
☐	Are there areas for improvement in the methodology, collaboration, and participation?	**§7.3** **§7.4**	

Guiding questions
Socially Responsible Research

The questions in the checklist are explained in more detail below. Additional guiding questions are suggested, according to the various steps of the research cycle. These questions serve as a support for designing, conducting, reporting and disseminating (bio)medical research in a societally responsible manner.

1. Problem analysis

Literature review

1.1 Can you justify why this research is valuable and worthwhile? Could the research question perhaps be sufficiently answered using existing literature, by consulting or doing a (systematic) literature review (**Box 1**)? Is there a relevant knowledge gap in the literature? After all, the most sustainable research is the research that does not need to be performed.

> **Box 1 | Evidence-based research**
>
> Evidence-based research is a movement created to prevent research findings with no relevant contribution to society, also known as 'research waste'.[9] An example of research waste is when the research question could be sufficiently answered using existing literature.
>
> An important aspect of evidence-based research is conducting preliminary research, by consulting or doing a (systematic) literature review. In recent years, the number of published systematic reviews has greatly increased. It is therefore important to first check whether an up-to-date review on your topic already exists. This can be checked through databases such as **Cochrane** or **Epistemonikos**. In addition, confirm that there are no similar reviews in progress via **PROSPERO** or the **Open Science Framework**.
>
> If no up-to-date and high-quality literature review is available, you should conduct a systematic review yourself. To do so in a valid way, a critical appraisal of the selected literature is essential. If you need help in preparing a systematic literature review, consider seeking advice from your university library or a methodologist.

Societal value

1.2 Does this study reduce the use of unsustainable (healthcare) systems, therapies or interventions, both now and in the future (**Box 2**)? Or does this research contribute to the transition toward a sustainable society? For example, research about prevention, the protein transition or circularity in healthcare.

1.3 Does this study contribute to increasing equity at the (inter)national level (**Box 2**)? For example, consider genetic predisposition towards prostate cancer. Current knowledge on this is primarily based on populations of European and North American descent, while Asian, South American and African populations are underrepresented.[10] This underrepresentation is a common trend in genetic research.

Stakeholders

1.4 Has the relevance of the research question been tested among stakeholders? Think about patients and patient organisations, healthcare professionals, residents, schools, community organisations, local authorities, and/ or businesses. Are there other research questions which they believe should be prioritised and included in the study? Research has shown that new studies do not always align with patients' needs. For example, trials tend to focus on pharmaceutical treatment options, while patients and healthcare professionals often prioritise non-pharmaceutical treatments.[11]

Side effects

1.5 Are there any secondary benefits in terms of equity and sustainability, in addition to the primary goal? For example, a new treatment option that generates less carbon emissions or waste than regular treatment.

1.6 Are there any additional societal issues or implications arising from this research? Are these desirable or not? For example, genetic modification using CRISPR-Cas, xenotransplantation, specific gene selection through embryo research, or the (potentially infinite) continued growth of human cells using organoids.

Box 2 | Examples of research agendas on societal issues

A research agenda is a list of potential research questions for researchers. Often, research agendas are developed in collaboration with stakeholders (e.g. patients, experts, citizens) to identify knowledge gaps and topics that should be prioritised. Below several examples of research agendas related to socially responsible research are listed.

The **James Lind Alliance** provides an overview of topics that are important to patients. The **KNAW Planetary Health** report outlines knowledge gaps regarding the relationship between climate change, biodiversity loss and global environmental pollution. The **Dutch NFU Research Agenda Prevention** offers an overview of relevant themes within prevention research (CH3). The **Dutch National Research Agenda for Family Medicine** contains a list of practical topics focused among other things on prevention (§4.4.11) and diversity (§4.4.9).

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2. Research plan

Research team

Positionality

2.1 Where do you position yourself within this study? How might your background, beliefs, (unconscious) assumptions, and hypotheses (your 'positionality') influence the study? For example, consider how your ability to communicate effectively with people from a migration background might be enhanced if you share that background yourself, or how you may focus on certain outcomes that you are personally inclined to find.[12]

Diversity

2.2 How diverse is the research team? What backgrounds, perspectives, values, or areas of expertise, both within and outside your country, are important for this study? Are these recognised and valued? Which perspectives are missing, and how can these be actively incorporated into the study? However, be mindful that one patient or stakeholder in the research team cannot represent the entire (patient) group. For this, an additional survey can be conducted within the broader (patient) group.

Communication

2.3 How is the (non-verbal) communication within the research team? Is it inclusive, focused on the individual rather than stereotypes, and easily understandable by everyone (**Box 3**)? Is there room for feedback?

Box 3 | Inclusive communication

The use of inclusive language is the use of words that avoid prejudice, exclusion, and stereotyping based on an individual's (minority) identity. Inclusive communication goes beyond written or spoken language and includes images and symbols. For example, it involves respecting pronoun preferences, avoiding stereotypes, acknowledging diversity in gender and sexual orientation, avoiding hierarchical language, and not defining individuals by their limitations.[13]

Resources: **APA Bias-Free Language**, **UU Inclusive Language in Writing** en **Critical Selfpositioning Tool**.

Methodology

Methodology

2.4 Is this the best possible methodology or (laboratory) technique to answer the research question, taking into account logistical and financial possibilities? Are suggestions from previous research incorporated? If necessary, seek help from a methodologist. Also consider relatively new types of research, such as participatory action research (**Box 4**).

Stakeholder engagement

2.5 Are stakeholders structurally and genuinely involved in the design and execution of the study? On what grounds were the participating stakeholders chosen? Patient participation is highly valued by the Dutch Ethical Review Committee. Since 2023, ethical review applications for clinical research in the Netherlands include review questions on the extent of patient participation.[14]

Bias

2.6 What are possible sources of bias in this study? What is being done to minimise these (as much as possible)?

Box 4 | Participatory action research

Participatory Action Research (PAR) is a practice-based approach to research and particularly suited to address complex societal problems. It can include both qualitative and quantitative components. PAR often aims to bring about social change and empower stakeholders. Thus, those affected by the problem have an important role in designing and conducting the study. They are active co-researchers rather than passive respondents and are valued, among other things, for their experiential knowledge. For example, key figures within a community who know their community well and can share insights in how to design an intervention effectively.

In short, from research 'about' people to research 'with and for' people. One of the goals of PAR is to implement actions early on. Knowledge is generated by reflecting on the impact of these actions (knowledge-by-action), for example, with the implementation of a new exercise program for people with diabetes. Follow-up actions are then implemented to improve these interventions for the community (knowledge-by-action), for example, by making the exercise group more accessible.[15]

Example: **'Healthy and Happy the Hague' project**

Preregistration

2.7 In the context of Open Science (**Box 5**), has any thought been given to pre-registering the study design (research question, method, analysis plan and associated reasoning behind choices made)? For example, using **PROSPERO** for meta-analyses and **ClinicalTrials.gov** for clinical trials. Preregistration provides transparency, prevents modification of hypotheses after analysing the findings, and prevents others from conducting the same study at the same time.

Box 5 | Open Science

A 2021 study showed that only 46% of the included cancer studies were replicable and 92% of the studies showed a smaller effect size when reproduced.[16] This illustrates the replication crisis in the scientific world, the problem that researchers cannot repeat the original experiments of (groundbreaking) studies or do not obtain the same results.

To prevent this in the future, the Open Science movement was born. Open Science is about ensuring transparency, collaboration, and accessibility of scientific research for all levels of society. From laypeople to professionals, locally and internationally. The movement encourages scientists to share all study data, from study design and raw data to software, as early on as possible.[17] The movement aims not only to make science transparent and accessible, but also reproducible and to improve the quality of scientific results. Moreover, by avoiding unnecessary repetition of experiments, it is both sustainable and cost-effective.

Participants

Representative sample

2.8 Do the participants reflect the target population? Which population benefits from this study? Is any group (unintentionally) excluded? This is further explained in **Box 6**. What if the study fails to obtain a diverse sample? How is this handled in the interpretation of the data and the conclusions drawn from it?

2.9 Do you expect that diversity characteristics (e.g. socioeconomic position or self-reported ethnicity) may influence the outcomes? If so, what is the effect of including more or fewer participants from marginalised groups? For example, lung cancer is more common among lower-income populations, while skin cancer occurs more often among higher-income populations.[18]

Box 6 | Study population and generalisability

Many datasets focus on the common denominator among patients, to represent 'the average patient'. Characteristics of minorities are seen as confounding factors in an analysis. For example, age, sex, gender, socioeconomic position, cultural background, education level and neurodivergence (variations in the human brain such as ADHD, dyslexia, or dyscalculia). Randomised controlled trials often use strict inclusion criteria to create a homogeneous dataset, often excluding people with comorbidities or other sources of variation. However, these strict inclusion criteria ensure that the results are less generalisable to the broader population, and only apply to the 'optimal patient' who meets all the inclusion criteria.

Resources: **Sex and Gender Equity in Research (SAGER)** guidelines and **Genderful Research** help include gender and sex in study design, analysis, results and interpretation. Even in vitro studies, results may differ between cell lines of different genders, see **Analyzing Sex in Tissues and Cells**.

Variables and analysis

Baseline variablesn

2.10 What baseline variables and categories do you use for diversity characteristics? On what scientific literature are these based? Many diversity characteristics are interrelated, so be mindful of which characteristic you are actually studying. For example, ethnicity often incorrectly functions as a 'proxy' for socioeconomic position or access to healthcare.[19] For a tool to help identify relevant diversity characteristics, see: **Rainbow Model**

Relevance of outcome variables

2.11 Are the outcome variables (clinically) relevant and applicable in practice, given the available resources and existing systems? For example, consider the use of certain cut-off values or categories. Are these chosen in collaboration with stakeholders, such as healthcare professionals and patients? Note that current guidelines, cutoff values, and categories are often based on non-inclusive research. Be aware of this when choosing your variables.

Subgroup analyses

2.12 Are subgroup analyses performed? If so, are there specific subgroups in the study in which the effect differs from that of the overall group (effect modification)? For example, consider drugs such as Zolpidem (a benzodiazepine) which are metabolised more slowly by women than by men.[20]

Experiential knowledge

2.13 Is knowledge collected (qualitatively) from participants? How is it used? For example, think about experiential knowledge, meaning the practical insights people have gained through specific experiences and their reflections on those experiences.[21]

Means

Laboratory animal use

2.14 Are animal models or other animal-derived materials (e.g. BSA in culture media or antibodies) necessary for the study? Can experimental animal use be replaced, reduced or refined (in that order) without compromising the power of the study?[22] Can valid animal-free alternatives be used? For example, organoids, 3D bioprinting, organ-on-a-chip and digital models. For more information, see: **3Rs Centre Utrecht**

2.15 If laboratory animals are used, are appropriate guidelines met? What is the rationale behind the sample size calculation? Is the chosen sample size as small as possible, but with enough power for the intended statistical analyses?

Finances

2.16 Is sufficient funding available for thorough preliminary research (systematic literature review)? Is sufficient money set aside for open access publication and dissemination of study findings to stakeholders?

Justification of costs

2.17 What are the financial costs of the study? How can costs be saved? And who (indirectly) pays for these costs? Can all expenditures be justified towards those who (indirectly) pay for them? And vice versa, are these funders themselves free from conflicts of interest?

⚙️ 3. Execution

Participants

Recruitment

3.1 How is ensured that marginalised groups are adequately reached during participant recruitment? How are sufficient opportunities for participation ensured for these groups? For example, consider people who need childcare during appointments, vulnerable elderly individuals, people with limited digital skills, those who need an interpreter during conversations, or key figures such as staff in community centres or religious community.

Inclusive communication

3.2 What is the communication with participants like? For example, think about the use of inclusive language, literacy, digital skills and command of the relevant language (**Box 3**). Are these aspects also taken into account when informed consent is taken? And in which context are participants communicated with? For example, living in poverty is often associated with shame and loneliness. Sharing your story in an unfamiliar group of people therefore does not feel appropriate for some people in poverty.

Means

Minimising ecological footprint

3.3 In what ways does the study have an environmental footprint (e.g. waste generation, CO_2 emissions, water consumption, and resource use)? Are there options to reduce this footprint? For example, by applying the R-ladder to reduce material use and waste production (**Box 7**). Could study materials be used second-hand?

3.4 Is it possible (using digital communication) to minimise paper use and travel by researchers and participants? For example, by implementing e-consultations, having blood or urine samples collected at participants' homes, and having online meetings with international team members. If travel is still necessary, is it possible to combine appointments and to use public transportation or cycle?

Box 7 | R-ladder

R-ladder indicates the degree of circularity.[23] While circularity is often associated with 'recycling', this actually ranks low on the R-Ladder. The highest step is 'refuse and rethink', which causes the least use of resources. The R-ladder can be used to reduce material use and waste production:

Refuse and Rethink: Moving away from products or materials that are not truly needed, and intensifying product use (for example, by sharing materials or multifunctional use).

Reduce: Using resources more efficiently and reducing consumption.

Reuse: Reusing or repairing old products.

Repurpose: Reuse parts of old products (for another product or purpose).

Recycle: Processing materials into raw materials.

Efficient (lab) planning

3.5 Are (laboratory) experiments carefully planned so that they can be performed efficiently? Are appropriate controls included? Can samples or consumables be shared with other researchers? Laboratories use huge amounts of resources, produce a lot of (plastic) waste and are energy intensive.[24,25] **LEAF** (Laboratory Efficiency Assessment Framework) is a program developed in the United Kingdom that helps scientists conduct their laboratory work in a more sustainable way.

3.6 Is Green and FAIR data management being used (**Box 8**)? When running computationally heavy analyses, can a test sample be run before the entire dataset is analysed? Are there more sustainable algorithms available which require less time and energy?

Box 8 | Green and FAIR data management

While switching to digital platforms may increase sustainability, the digital world and software can still produce a significant carbon footprint, both in terms of energy consumption as well as the metals and minerals required to manufacture digital equipment. From using energy-saving mode, sending emails with links to files in the cloud instead of direct attachments, to regularly cleaning up your data. There are numerous measures to reduce the ecological footprint.[26] In addition, the impact of research can also be increased by ensuring that findings are effectively shared and used by other researchers.

To this end, the **FAIR-principle** was developed. FAIR stands for Findable, Accessible, Interoperable, and Reusable. It is a set of guidelines to make research data easily findable, accessible, interoperable, and reusable.

Resource: **Research Data Management Support**

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4. Results

Inclusive representation and language

4.1 How are the results presented? Does it do justice to different groups and how they want to be named (**Box 3**)? For example, preferably present ethnicity and gender in the way participants themselves reported it, rather than the way assigned by researchers.

4.2 Is there an equitable order in the presentation of subgroups? Is the correct group assigned as the reference group? For example, sort subgroups by group size or alphabetical order, rather than selecting certain groups as the reference group by default (such as 'White' or 'Male').

4.3 How are results visualised? Are figures clear for the reader to see and understand? For example, use colour combinations appropriate for colour-blindness. Avoid green-red combinations (preferably use blue-orange) and try to use different shapes/textures whenever possible. Resource for checking your figure: **Color Blindness Simulator**.

Clinical relevance

4.4 Are the results not only statistically significant, but also clinically relevant? Clinical relevance can be assessed by consulting with patient or healthcare representatives. For example, is a 0.5 difference in pain scores clinically relevant in the eyes of the target population?

Null findings

4.5 Are all null findings described, so all results that are not statistically significant? Reporting when no significant difference is found, for example between subgroups, could prevent unnecessary additional studies in the future. More and more scientific journals recognise the importance of publishing null findings, and some journals even specialise in these: **Journal of Trial and Error**.

Negative side effects

4.6 Does the interpretation of the results take (negative) side effects into account? For example, medical side effects, CO_2 emissions, and material use.

5. Conclusion & Discussion

Representative conclusion

5.1 Do the findings truly support the drawn conclusions? Or are the results (unconsciously) presented more favourably than they actually are?

Objective referencing

5.2 How do the findings compare with those in the existing literature? Are comparable studies referenced in a systematic and transparent way? Research shows that often only a small proportion of comparable studies is cited.[27] For example, positive, significant and supportive studies are cited more frequently than negative, non-significant or critical studies. Reference choices are often influenced by personal preferences and strategic considerations, rather than on a systematic and transparent approach.[27]

Generalisability

5.3 What is the specific context of the study and what are underlying assumptions? To what extent can the findings be generalised, for example, to populations other than those included in the study? For example, consider differences in healthcare organisation in different countries, with some patients first presenting at a general practitioner and others directly at a (teaching) hospital. Or consider the generalisability of in vitro findings to populations with different biological or environmental factors.

Applicability

5.4 To what extent is it practically feasible to implement these findings in practice? Why (not)? For example, consider a diagnostic biomarker that appears to have high sensitivity and specificity but is also very expensive to determine, or an intervention that requires a lot of time from already busy healthcare professionals.

Recommendations

5.5 Is future research about the same topic necessary? Specify what a follow-up study should look like to be of value to the target audience and/or society.

5.6 Do recommendations for future research consider diversity, inclusion and environmental sustainability? For example, a lot of research has been conducted among cisgender people, but little has been done among transgender people. Recommendations can be used to address these kinds of 'research gaps'.

6. Reporting & Dissemination

General

Reporting guidelines

6.1 Are relevant reporting guidelines used in reporting the study (for example from the **EQUATOR network**)? This ensures that relevant information is reported, making research replicable, useful for (clinical) decision-making, and suitable for inclusion in systematic reviews.

Digital options

6.2 Is it necessary to print the outcomes or can these be shared completely digitally? Is it possible to present a poster digitally? Make an informed choice about this, keeping the target audience in mind (e.g. elderly people). Can a printed poster be used again or hung somewhere where the results remain visible and read?

6.3   Is attendance at a meeting or conference that requires flying truly necessary? Could a digital or hybrid option be chosen instead, or an event closer to home? Is it possible to travel to conferences by train?

Recognition

6.4   Are all contributors appropriately acknowledged in the author's list or acknowledgments, including individuals from Low- and Middle-Income Countries (LMIC) or marginalised groups?

Scientific community

Preprint

6.5   How can relevant findings, including negative results, be shared as efficiently as possible? In the context of Open Science (**Box 5**), consider publishing a 'preprint' on **medRxiv** of **bioRxiv**, which allows findings to be publicly shared before formal journal submission and peer review.

Open Science

6.6   How can results best be shared within the scientific community? For example, by publishing in an open access journal. While these often involve higher fees, they allow anyone to read the research, including people in other parts of the world. Some universities have made agreements with specific open access journals to reduce fees for their researchers. Inquire about these agreements at your own university.

6.7   Can the raw data, analyses and choices behind the study design be made additionally available? This can be done, for example, as an article supplement (for additional methods and data) or through **Github** (for analysis scripts).

Society

Science communication

6.8   How and when will the results be shared with the participants? Can this be done in a transparent, engaging and accessible way? For example, using a video or a symposium.

6.9   Which groups have an interest in learning about the results? For example, patients, healthcare professionals, residents, students, municipality and/or companies.

6.10   What medium reaches them best? For example, using presentations, workshops, videos, visuals, social media (LinkedIn, X/Twitter, blogs, TikTok) or news releases.

6.11   How do the language and/or visuals make the study findings more understandable for the target audience? Many journals nowadays request lay or graphic abstracts to explain studies in a way that is accessible for patients, families, and other interested groups. A useful resource for writing a lay abstract is **Good Lay Summary Practice**.

6.12   Can the broader public be encouraged to participate more in thinking about the significance of new insights from research? For example, by community dialogues, public engagement through libraries or public participation in municipalities.

📋 7. Evaluation

Final value

7.1 In what ways has this study made a social and scientific contribution? For example, to which **Sustainable Development Goal(s)** has the study contributed? Who is involved in any evaluations, and what will be done with the findings? For example, by integrating these in the recommendations for the design of future studies.

Implementation

7.2 What steps can be taken to implement the knowledge gained in practice? Is there existing knowledge from implementation research that can be used for this purpose? Also consider reversing interventions that appear to have little or no (clinical) benefit.

Areas for improvement

7.3 In retrospect, are there areas for improvement in methodology and/or laboratory techniques? For each step, evaluate whether the protocol achieved the intended results. Where was any troubleshooting necessary? Can any improvements in a protocol be further disseminated for future projects and experiments?

7.4 If relevant, what are areas for improvement regarding the participation of particular groups? Was it possible to genuinely involve stakeholders at all stages of the study? Was collected experiential knowledge ultimately used? And was inclusion of marginalised groups always feasible? For example, trying to include patients with advanced Alzheimer's who, in practice, had difficulty lying still for a long MRI scan.

Closing remarks

Hopefully these questions have encouraged you to (further) consider topics that are currently relevant within academia and science. Just as society and science are constantly evolving, this document will continue to adapt to new insights. This handbook is intended as a (extensive) guide for students, (young) researchers or teachers to get started on these topics but is obviously not complete.

If you have any questions, comments or feedback after going through the handout, please feel free to contact Anjali Wijnhoven (**anjaliwijnhoven@gmail.com**) or Arte Groenewegen (**artegroenewegen@gmail.com**).

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