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Development and implementation of research integrity guidance documents: Explorative interviews with research integrity experts

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ABSTRACT

Research integrity (RI) guidance documents often lack sufficient details on handling specific RI issues causing the lack of harmonized approaches to RI and opening the way to research misconduct and other detrimental research practices. Standard operating procedures (SOPs) are developed and implemented by organizations for ensuring the uniformity and quality of performed actions. This study aimed to explore stakeholders' opinions on SOPs for RI, factors influencing the implementation of RI guidance documents and practices, and ideas for improvements in the RI field. We conducted semi-structured interviews with stakeholders from different groups. Data were analyzed using the reflexive thematic analysis approach, and three themes were developed. The first theme addressed participants' knowledge and perceptions on SOPs for RI and their impact on RI promotion and implementation. The second theme described different factors that have a positive or negative impact on the implementation of RI and RI guidance documents and practices, while the third theme addressed needed changes and ideas for improvements in the RI field. Participants considered SOPs valuable for RI promotion. SOPs should be developed based on and consistent with more general and aspirational guidance and through the dialogue with researchers and other stakeholders, to ensure their relevancy.

KEYWORDS

Research integrity; research integrity guidance; standard operating procedures; research performing organizations; research funding organizations

Introduction

Research integrity (RI) has a central role in preserving research robustness and adherence to RI principles, such as honesty, fairness, and accountability, and helps researchers avoid engaging in practices that may threaten the reliability of research results (Singapore Statement on Research Integrity 2010; ALLEA 2017). Although the research community continually promotes RI, the globalization of research, increased number of research collaborations, and advancement of science and technology may exacerbate existing RI challenges and impose new RI issues that need to be tackled (NASEM 2017).

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Despite individual factors such as personality traits, research experience, or individual's perceptions toward RI guidance documents and practices being important for fostering RI (Antes et al. 2007; Davis, Riske-Morris, and Diaz 2007; Tijdink et al. 2016), the research community has recognized that creating and preserving the environment in which RI is an integral part of research requires an overarching approach and includes the responsibilities of multiple stakeholders – research organizations, funding organizations, scientific journals, publishers, and researchers (Fanelli et al. 2015; Bouter 2018; Munafò 2019; Zwart and Ter Meulen 2019; Bouter 2020). While in the past more emphasis for promoting RI and preventing and sanctioning poor research behavior was put on the individual researchers, in recent years more attention has been given to other stakeholders, primarily research organizations, such as universities and research institutes, and funding organizations (Bouter 2015; NASEM 2017). For example, the initiatives, such as the Bonn PRINTEGER Statement and Canadian Try-Agency Framework on Responsible Conduct of Research (RCR) outline research organizations' responsibilities in promoting RI and RCR and creating strong integrity culture, providing support for researchers by raising awareness and offering education on RI issues, as well as in establishing RI structures and processes for handling allegations of misconduct (Secretariat on Responsible Conduct of Research 2016; Forsberg et al. 2018). Similarly, the Australian Code for RCR outlines main responsibilities of research organizations in preserving RI by defining their role in establishing good governance system for RCR and investigations of breaches, supporting the responsible dissemination of research findings and research data, and providing adequate support for research supervisors and students (NHMRC 2018a). Moreover, research organizations' responsibilities in strengthening RI in research evaluation practices, award systems, and collaborative working have also been explored, yielding recommendations for improvements and examples of good practices (Mejlgaard et al. 2020; Moher et al. 2020). Besides guidance for research organizations, some initiatives have outlined how funders and scientific journals could also contribute to the culture of integrity by creating clear RI policies and sanctions for RI breaches (GRC 2013; Collaborative Working Group from the Conference Keeping the Pool Clean: Prevention and Management of Misconduct Related Retractions 2018).

Some research and funding organizations have already taken action to put these ideas into practice (Boehme et al. 2016; Wellcome Trust 2018; Lerouge and Hol 2020). However, others may still have difficulties in adequately addressing RI issues and actively promoting the culture of integrity. This is evident from the prevailing RI problems that impede RI promotion and implementation – lack of clear and consistent RI policies and guidance documents in different organizations, as well as their diversity, lack of RI bodies and guidance on how to handle RI issues, existence of pernicious

success-related incentives and excessive competition that create irresponsible research climate and may lead to research misconduct (Haven et al. 2020; Olesen et al. 2020; Aubert Bonn and Pinxten 2021a, 2021b). The step toward organizational improvement in RI should include developing and implementing clear RI standards, guidance documents and practices, and comprehensive RI plans (Resnik 2009; Degn 2020; Mejlgaard et al. 2020). Although different types of RI guidance documents, such as codes of conduct, guidelines, checklists, or standard operating procedures (SOPs) addressing different RI processes and topics exist (Ščepanović et al. 2021), available research shows there is a strong heterogeneity in how both international and national RI guidance documents approach to RI, define research misconduct, as well as how they address different RI issues (Godecharle, Nemery, and Dierickx 2014; Aubert Bonn, Godecharle, and Dierickx 2017). The coexistence of value and norm based approaches to RI creates on one side general and broad guidance documents that rely on fundamental RI principles, and on the other side more detailed guidance that contains explicit definitions and recommendations (Godecharle, Nemery, and Dierickx 2014). Further, the differences in approaches are evident from positive or negative guidance presented in RI guidance documents (Aubert Bonn, Godecharle, and Dierickx 2017). While some guidance documents are more focused on promoting good research practices and principles aimed at incentivizing researchers' positive behavior, others are more focused on defining the breaches of RI and the consequences for offenders. Besides diverse approaches to RI guidance, there are also prominent differences between RI principles, definitions, and recommendations provided across different guidance documents, which is related to the practical implications of guidance documents and how RI issues are handled across the globe (Desmond and Dierickx 2021; Ščepanović et al. 2021). Since guidance documents aim to guide and stimulate researchers and other stakeholders, such as research and funding organizations, to adhere to high integrity and professional standards for the benefit of the global research community and society in general, the currently existing differences should be minimized and more consistency, uniformity, and standardization introduced to RI guidance (Lind 2005; Desmond and Dierickx 2021; O'Grady 2021).

The requirement for consistency and standardization in RI conceivably requires developing more detailed oriented RI guidance documents. While some documents, such as codes of conduct, provide very broad guidance based on the aspirational norms and principles, other types of guidance documents, such as checklists and SOPs, are more detailed-oriented and aimed toward consistency in approaches to the same RI issues (Ščepanović et al.2021). SOPs are documents presenting a step-by-step approach to performing a certain action together with detailly describing the responsibilities of those involved in that process. They are used in various settings as

quality control tools that help achieve uniformity, transparency, and high quality of performed tasks (Barbosa et al. 2011; Akyar 2012). Moreover, SOPs are often used as a checklist by coworkers and auditors for easier monitoring of users compliance with procedures for performing tasks (Akyar 2012). For a long time, SOPs have been used in business and management and in medical setting for ensuring compliance with the highest standards of business and clinical practice (Akyar 2012; Nachtigall et al. 2008; Sajdak, Trembath, and Thomas 2013; Chen et al. 2016; Hunter 2020). Moreover, SOPs also exist in research settings, such as laboratories, to ensure that laboratory procedures are performed correctly, and that possible risks and harms are minimized (Mager et al. 2007; Barbé et al. 2016). These characteristics of SOPs make them an interesting tool for RI as they may help researchers better comply with RI standards and fundamental principles in their work. Moreover, SOPs can help researchers avoid engaging in research misconduct and poor research practices, and help research and funding organizations to improve monitoring of compliance with established RI principles. However, SOPs are still not common type of guidance documents for RI, and aspirational codes and guidelines are more dominant (Ščepanović et al. 2021).

To explore in-depth the issues related to the development and implementation of RI guidance documents and responsibilities of research organizations and other stakeholders in promoting RI and fostering the culture of RI, we conducted interviews with participants working or having experience in the RI field. Our objectives were to explore: a) the opinions about existing RI guidance documents and the potential role of SOPs for RI in research performing and funding organizations, b) the opinions on how to improve existing processes of developing and implementing RI guidance documents and practices, c) the conditions (barriers and facilitators) for effective RI implementation in different settings (research organizations, disciplinary fields, and countries), and d) novel ideas or experiences for positive changes in RI.

Methods

Study design and participants

Since we aimed to explore in-depth knowledge on RI guidance documents and issues related to the RI field from participants from different research organizations, disciplinary fields, and countries, we conducted semi-structured interviews that are suited for obtaining thoughts from individuals in certain group and enable new ideas to be brought up and discussed during the interviews (Adams 2015). In reporting the findings, we followed the

Consolidated criteria for reporting qualitative research (COREQ) checklist (Tong, Sainsbury, and Craig 2007).

First, we developed a study protocol (available at: https://osf.io/srzup/and interview guide. The first version of the interview guide was developed by one author (RR)and discussed with two authors (IB and AM)to decide on the questions to be included in the guide. After the pilot interview, three authors (RR, IB, and AM)assessed the appropriateness of the interview questions in relation to the study aim. Based on the assessment and discussion, the questions were modified to be more focused on SOPs as RI guidance documents, as well as to barriers and facilitators of successful implementation of RI guidance documents and practices in research performing and funding organizations. We used a purposive sampling to recruit participants from different stakeholder groups and conducted interviews with 23 participants who have experience working in the RI field: researchers/educators (n = 16), policymakers (n = 5), members of RI/RE (research ethics) committees (n = 5), members of industry (n = 6), members of funding organization (n = 1). The numbers do not add up to the total number of participants because participants could select multiple stakeholder groups in the demographic questionnaire. The sample consisted of 13 female and 10 male participants. The median years of work experience related to RI were 10 years (range 2–32). Most participants were from the European countries (1 each from Austria, France, Germany, Luxembourg, Norway, Poland, and Portugal, 2 from Belgium and Croatia, 3 from Italy and United Kingdom, 4 from the Netherlands); one from the USA, and one from Australia. Participants were primarily identified through personal contacts of the Standard Operating Procedures for Research Integrity (SOPs4RI)[project consortium and approached via e-mail or in person by the authors or project collaborators. We used the opportunity to recruit new participants and conduct interviews while participating in the meetings of EU projects related to RI and RE and at the 6th World Conference on Research Integrity (WCRI, Hong Kong, 2019). We had 3 dropouts from the study – 2 participants did not feel comfortable participating because of the lack of RI-related experience, and 1 participant had other commitments.

Setting and data collection

The interviews were conducted from March to July 2019, face-to-face (n = 14) or online (n = 9), depending on the participants' availability. Based on the predefined workload set out in the study protocol, face-to-face interviews were conducted at the authors', collaborators' or participants' institutions, the EU projects meetings and 6th WCRI. The interviews were conducted using the interview guide (Appendix 1), and demographic data were obtained with the questionnaire (Appendix 2). During the interviews,

only the facilitator and the interviewee were present. In the pilot interview, two facilitators (RR and IB)were present to better assess the need for possible changes in the interview guide. Non-participants were not present during the interview to ensure adherence to the principles of privacy and confidentiality. Based on the predefined workload set out in the study protocol, interviews were facilitated by authors (RR and IB)and IB (male; postdoctoral researcher; PhD student at the time of conducting the study; facilitated pilot interview) and collaborators in the SOPs4RIproject (4 males and 2 females; 4 senior researchers and 2 junior researchers – PhD students at the time of conducting the study; facilitated total of 8 interviews - see acknowledgment).Most of the participants were familiar with the research team, as the RI research field is rather small. During the recruitment process, the participants were informed about project information and goals. The analysis of the interviews was performed by two authors (RR and VT)one of them (VT)who had previous extensive experience in qualitative analysis. The interpretation of the study's results was performed by 3 authors (RR, VT, and AM). The duration of the interviews varied from 30 minutes to 1 hour and 15 minutes. The interviews were conducted in English and audio recorded, except one interview in Polish and two in Italian because these participants felt more comfortable speaking their language. Recorded discussions were transcribed verbatim (interviews conducted in Polish and Italian were translated in English after the transcription). Field notes were made by the facilitators during some interviews, mostly as a note to themselves to mark additional questions that were not defined in the interview guide but rather emerged from the discussion. However, the field notes were not mandatory to be taken, and we did not included them in the analysis. The transcripts were not returned to the participants for comments and corrections. Repeated interviews were not carried out.

Ethical considerations

During the recruitment process, all participants were provided with the information letter describing the study aim and their involvement, and the informed consent form (Appendix 2). To participate in the study, they had to sign the informed consent and send it back to the researchers before the commencement of the interview or hand it at the time of the interview. Voice recordings from the interviews were used only for obtaining the transcripts, and the transcripts were pseudonymized. The ethics approval for conducting the interviews was obtained by the Ethics Committee at the University *University of Split School of Medicine* (Document No. 2181-198-03-04-19-0011).

Deviations from the study protocol

In the study protocol, we initially planned to conduct interviews with different stakeholders' groups (researchers/educators, policymakers, members of RI committees, members of industry, and members of funding organizations). During the recruitment process, we decided to also include the members of RE committees. As we wanted to include participants from various countries, we considered that some countries and organizations may not have established bodies dealing specifically with RI issues, but that RE committees handle RI issues in many research organizations (Marušić 2019). Another deviation from the protocol was related to the software used for conducting the online interviews. In the study protocol we informed the participants that the online interviews would be conducted via Skype for Business platform. Due to the feasibility issues, we proposed another platform – FreeConferenceCall (FreeConferenceCall, Long Beach, CA, USA). The participants were informed about this change prior to accepting the invitation to participate in the study.

Data analysis

In the analysis, we followed Braun and Clarke's reflexive thematic analysis approach (Braun and Clarke 2006; Braun et al. 2019), which enables the flexibility and detailed understanding of the explored issues. After familiarization with data through the transcripts, we used NVivo 12 Plus for Windows (QSR International, London, UK) for the analysis and the generation of the initial codes. In developing the codes, we followed the inductive approach and used semantic codes, which captured the explicit meaning of the data and were not focused on the potential deeper, conceptual meaning. The second phase of the analysis included constructing themes, followed by revising and modifying these themes until the final list of themes was developed. In the reflexive thematic analysis approach, the concept of data saturation is not applicable (Braun and Clarke 2019); hence we did not seek to obtain data saturation.

Results

Three main themes were developed from the data (Figure 1).

Theme 1: Divergence in knowledge and perceptions about SOPs as type of RI guidance documents

The first theme deals with the participants' knowledge and perceptions on RI guidance documents, mainly SOPs for RI promotion. This theme describes

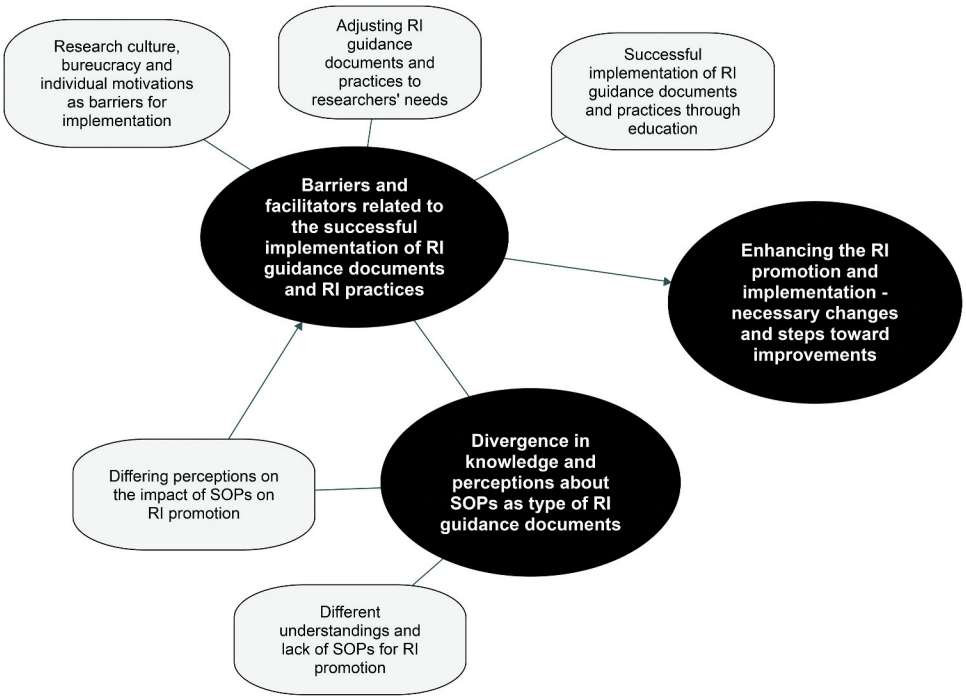

Figure 1. Thematic map of themes and sub-themes. SOPs – standard operating procedures.

both the participants' different understanding of SOPs for RI as RI guidance documents and different perceptions toward their applicability and impact on promoting and fostering RI. Thus, two sub-themes "Different understandings and lack of SOPs for RI promotion" and "Differing perceptions on the impact of SOPs on RI promotion" are developed as a part of this theme.

Different understanding and lack of SOPs for RI promotion

The participants were not familiar with the term SOP in the context of RI. While some participants were familiar with step-by-step procedures that describe in detail specific processes and the roles of those involved, most of the participants did not distinguish between detailed or general guidance documents related to RI. In most cases, when asked about the SOPs for RI, the participants referred to various established and internationally known RI guidance documents that they perceived as RI standards – guidance documents and practices widely accepted and commonly used for RI promotion. In this context, they often mentioned the European Code of Conduct for RI (ALLEA 2017). Further, several of the participants considered reporting guidelines, such as those available at the Equator Network (EQUATOR Network 2021), as SOPs. This was because they contain step-by-step

instructions on how to report research results. Some participants gave more practical examples of what could be considered an SOP, such as existing guidance for submitting images to the journals.

> P2: Well I guess the first one, the basic one is the ALLEA code.

> P17: Well, what I sometimes use is the EQUATOR Network. [...] So there are a lot of reporting guidelines connected, so it's not just one standard operating procedures that is there, but it's a collection.

> P19: I think the most common SOP that we are using and beginning to require are EQUATOR Network reporting guidelines for specific study types.

> P3: I guess one other area that I'm familiar with, where there is something that you might consider of sufficient detail to be an SOP, and that is in the preparation of images for submission to journals.

Several participants mentioned they were familiar with SOPs in general as they are used for describing different research procedures, such as the collection of samples for research. However, when asked about the SOPs for RI, they stated they were not aware of SOPs related explicitly to RI issues but instead that RI guidance tended to be more aspirational.

> P12: I do not know of any SOPs or procedures that are called standard operating procedures in that field. I know of SOPs in my research field, like ... in epidemiology when you do a survey, you have standard operating procedures, if you take samples you have SOPs and that is a protocol with the detailed spelling out of what you should do and how you should do it. So, I am not aware of SOPs in the field of RI.

> P10: No, frankly ... I am, myself not aware of existing SOPs pertaining to research integrity. I have to admit that.

> P3: I am not aware of anything that you would call an SOP. They tend to be much more high level guidelines very, you know, by which I mean quite vague, quite general and I'm thinking about things like the Singapore statement which would, you know, that would be a sort of a good example of a high level aspirational guideline.

Differing perceptions on the impact of SOPs on RI promotion

The participants mostly agreed that SOPs would be a good addition to the tools to foster RI. However, a few participants had more favorable opinions, while others were somewhat skeptical. Some participants saw SOPs as a guidance tool that would help researchers easily follow their research tasks, detect and resolve RI issues, and avoid sloppy science.

> P8: I really think that the standard, at least for the scientists, I really think that they need the standard operating procedures. [...] And that I think the SOPs could really help, help them to have a more scientific focus or approach to research integrity and research ethics issues.

> P22: Standardizing all kinds of procedures is very, very helpful for those who have to work with it and do the work because they hardly have a grip on, on all kinds of processes. So the better is written out, the bigger the chances that it will prevent sloppy science [. . .].

Other participants were quite skeptical that the development of step-by-step guidance for different RI issues in different research areas and research organizations was feasible. One participant mentioned that SOPs probably cannot influence researchers' attitudes toward RI and that RI entails more than mere following of procedures. Others thought that SOPs could be very useful for RI guidance and easy to develop and implement in research organizations and certain disciplinary fields. However, they doubted the possibility of funders having SOPs for RI, and were skeptical toward SOPs as an adequate RI guidance in academic areas where there was less technical and procedural work and more freedom of creation and pursuit for innovation.

> P3: [. . .] As I said, I think they're useful for the technical things or the things that people genuinely didn't know were a problem. I don't really believe though the SOPs can have much influence on culture.

> P12: So, culture, if you have a culture of looking for innovation, for creative, maybe it will be less likely to have very strict standard procedures [. . .].

> P2: But I think where it becomes a little bit tricky is . . . it's easier to look at it when it's the sciences. Meaning life science, health science, even social sciences. It's easier to pick up. But when you're looking at other things like the creative arts and music, and people who do music research and conservatories type of stuff, that's a lot harder.

> P12: In RPOs [Research Performing Organizations] you have to have SOPs for operating piece of equipment, for handling animals and so on, but that is very practical. I mean, it is sort of recipe on how you work, and that will be beneficial for RI. But in RFOs [Research Funding Organizations] I do not know how you could have very strict SOPs. You can have guidelines, recommendations, you could check. I do not think SOPs can be implemented in RFOs.

Theme 2: Barriers and facilitators related to the successful implementation of RI guidance documents and RI practices

The participants recognized the process of translating and applying RI guidance in real-life research situations as vital for fostering RI and avoiding research misconduct and detrimental research practices.

> P2: You have to have the way to roll it out now, to actually implement those [. . .].

This theme focuses on different factors that positively or negatively impact the implementation of RI guidance documents (including SOPs) and RI practices, in research organizations, particularly those that may affect

researchers' adherence to RI. The theme captures and describes both the system of science and researchers-related factors that play a role in implementation and the interrelatedness of these factors. Three sub-themes were developed – "Research culture, bureaucracy, and individual motivations as barriers for implementation", "Adjusting RI guidance documents and practices to researchers' needs" and "Successful implementation of R guidance documents and practices through education".

Research culture, bureaucracy, and individual motivations as barriers for implementation

The participants mentioned several factors related to the research culture in the research community and to individual researchers, which may negatively impact RI and the implementation of RI guidance documents and practices. The issue often mentioned as problematic for the research community was the absence of consistency and harmonization. There are major differences between the academic systems and cultures in different countries and between disciplinary fields, and these were perceived as a significant issue for RI. The participants perceived RI as a global endeavor that aims for the uniform application of fundamental principles and norms.

> P17: Yeah, and I think that that's really a challenge for the research integrity. Because research is a global thing but the culture is so different across the world. So that it's very difficult for research integrity because you want the same rules to apply to all of us because the … yeah, because research is a global, a global endeavor.

> P9: Philosophy of science is a very different research culture than an applied ethics. […] yeah those are two different, very different research cultures.

Because of these differences, existing RI guidance documents often contain various definitions, such as definitions of research misconduct and questionable/detrimental research practices, which should be uniform and universally applicable. This further leads to the differences in how RI guidance documents, and RI practices and regulations are applied and interpreted in different settings, making it difficult for researchers to figure out what rules to comply with, hence complicating RI implementation.

> P2: […] And so, when you have people writing SOPs about what is research misconduct, at the base line there's not even agreement on what research misconduct is.

> P11: The definition given by the US is not the same definition that we use in Europe for example. […] The European Code of Conduct tried to put a definition but if you look at the Danish code and the ALLEA [All European Academies] code it's not the same definition. […] So at the European level, we have some difficulties to understand how we could harmonize.

> P12: Well, I can tell you one thing. There's still not a harmonization on even the definition of research misconduct. And so, when you have people writing SOPs about what is research misconduct, at the base line there's not even agreement on what research misconduct is.

Besides the lack of harmonization regarding research misconduct, the participants mentioned additional issues in the research community related to different pressures and competitive research culture that often hinder the implementation of RI guidance documents and practices. Pressure to publish in high-impact factor journals, pressure to publish a lot of research to advance in career, or pressure to obtain funding are seen as factors that stimulate poor research behavior and encourage a research culture in which RI is not an imperative.

> P5: So I think currently the main negative impact on the research cultures is the publish or perish situation [...].

> P18: In academia in particular I think there are a lot of pressures. Pressure to publish, pressure to get in funding, pressure to, actually supervise lots, lots of students.

In addition to these external factors, the participants also mentioned factors related to individual researchers: internal motivations pertaining to career advancement, financial gain, success, and awards, which are often the reason why researchers do not adhere to RI guidance documents and practices.

> P1: So … most generally, besides ignorance that I've mentioned before, serious misconduct is, I guess, always related to some kind of personal gain [...]. Some kind of gain whether it's a, it's fame or money or, you know, promotion or … That, that would be I guess main reasons that I can imagine somebody would decide to, to engage in misconduct.

> P19: I think motivations often are two sided. And so, you want to believe, we want to believe that researchers are inherently honest and motivated for altruistic reasons. That's we all want to believe at. But then along the way there are motivations that can counter that altruism. Various forms of bias. The desire for success. Can sometimes turn into the desire for positive results. And then the desire for additional funding and grants.

However, we noticed that participants saw researchers' motivations as consequences of the current culture in the research community, indicating that fostering RI and implementing RI guidance documents and practices should be an all-encompassing process that includes RI promotion efforts on different levels.

> P3: I mean if there were no rewards for publishing, for example if you are never measured by your publications and publications didn't carry any reward then I don't think we would ever have a problem, say, with predatory journals, we wouldn't have a problem with authorship, we wouldn't have problems with

> plagiarism. The whole thing would go away. So it really depends on the incentives and if you put too big an incentive to publish then yes that's when you start to get the problems with all those things I just mentioned.

In addition, researchers' perceptions of RI guidance documents and practices were also perceived as important factor for implementation. The participants mentioned that researchers often have negative perceptions of RI guidance documents and practices, considering them irrelevant for their research, a formality that needs to be fulfilled to satisfy the bureaucratic requirements, or an administrative burden that slows down the research progress and diminishes creativity and autonomy.

> P4: [. . .] Ethical considerations are always secondary. Cause that, that's not their interest. That's just something that they need to consider and sometimes, sometimes do something about it in order to focus or work . . . [. . .] Probably minimum effort that you need to spend and that you spent on that. And then, and then just, you know, yeah, you tick that box, yeah. It's done, you've done it. It's ethically okay and so on. So for the majority of cases, I think, that's the approach.

> P5: One of the issues with procedures is that they look like administrative burden for most of the, of the researchers. [. . .] Another major issue is that, I think is, that a lot of researchers will consider that, all these procedures are going to reduce their innovation, the capacity for innovation. It will be a barrier to having new ideas [. . .].

Adjusting RI guidance documents and practices to researchers' needs

The participants also referred to factors that may facilitate the implementation of RI guidance documents and practices, and that are strongly related to the previously mentioned issues and challenges – research culture, harmonization and bureaucratic challenges, and individual motivations for using RI guidance documents and practices. These factors are proposed as potential solution for eliminating the implementation barriers. According to the participants, researchers' needs related to the disciplinary field or research methodology specifics should be taken into account already during the development of RI guidance documents so that created RI guidance and practices are perceived as relevant by researchers. Tailoring RI guidance documents and practices to researchers' needs was seen as a prerequisite for successful implementation at individual researchers' level. It directly impacts researchers accepting RI practices and understanding their importance for research.

> P4: [. . .] I think that a crucial point is whether, whether the users of this SOPs find them relevant for them. [. . .] So you can come up with beautiful SOPs but if users don't find them relevant or perhaps don't need, don't feel they need them, then I don't think you'll . . . you'll reap much success with that. [. . .] So it's, it needs to be based in practice and practical experience. So, that's, I think one of the important

element or feature of the SOP. So that it's as close to the real experience of someone who is doing that procedure as possible.

P14: [...] in short, give concrete application to these principles taking into account that precisely, that maybe we can't make an application the same for everyone, but it will have to be articulated according to different contexts.

P16: [...] I think every subject field should have and has its own standards because the topic, the subject of the research is so, or the object of the research, is so different. So yeah, I think it should be done per research field.

Successful implementation of RI guidance documents and practices through education

The participants most often referred to RI education as a crucial aspect of successful implementation. RI education was seen as an active approach to implementing RI, which contributes to raising awareness and obtaining knowledge on RI issues and exiting RI guidance documents and practices, and helping researchers learn where to find and how to use available RI guidance in everyday work.

P2: If you gonna require people to adhere to them, you have to train people to them. So you need to set up a training plan, so everybody knows, knows about them, knows how to find them and knows the content and understands the content of those SOPs.

P15: I think that the biggest thing is raising awareness and education, you know. [...] I can't say this strongly enough, you have to raise awareness and then you have to teach people how to do things properly [...].

P17: Because I think if researchers better understand why they have to do it in a certain way, then they don't feel like it's, it's another rule, it's another bureaucracy thing. But they, if they understand why they have to do it that way they are also more likely to do it the right way right away.

P19: I think education for responsible conduct of research is key.

However, the participants believed that for RI education to be effective and contribute to RI implementation and awareness-raising, it should be thoroughly planned and carefully structured and targeted. The participants emphasized the need for continuous RI education and training for researchers at all career stages, especially education for mentors and supervisors. Another important element that emerged was tailoring RI education to researchers' needs. The participants discussed that basic and more general courses on RI are a good start when you first enter a research community, however as you advance in career and specialize in certain field, or become mentor and supervisor, RI education should be tailored to serve specific needs.

P1: So, early stage researchers are educated by their mentors but then mentors also need to get educated in about how to mentor [. . .].

P19: But I think it probably has to be tailored. And as you mature in your research career it needs to be tailored. I do agree that a version of RCR [Responsible Conduct of Research] training is needed at all levels.

P18: I think, I think they should actively, hold mandatory training sessions. So for example it could be a part of the on boarding. So when you've joined the research institution it should probably be a mandatory thing that right, as a researcher regardless of what you're studying you need to learn about these basic principles of ethical research. And then there might be more specific things.

The participants also emphasized the importance of having an adequate approach in providing RI education to researchers. They referred to the benefits of using real-life examples to help researchers understand why it is essential to be educated about RI issues and why RI is important for research and science in general. In this context, the participants mentioned that RI education often lacks active engagement and reflections of researchers and more often includes doing simple, one-time assignments in which researchers are not engaged enough in understanding the importance of RI. This may subsequently lead to noncompliance with RI guidance documents and practices. The participants supported more interactive and individual approach, accompanied by real-life examples because such approach helps more active engagement of researchers in RI courses or training and prevents seeing such training as an imposed administrative obligation.

P1: [. . .] and probably the best way to do it is through real life cases because they engage people and sometime, you know, when you hear about all those crazy things that people have done, that can interest students and then you can start from there, you can start having the discussion and, you know, helping them understand why it's important.

P2: And we try to teach one concept where somebody might do a one-hour lecture, we'll teach it in three minutes. With fun music and in a fun way and we try to show the plus side, yeah. Otherwise it's like rules and you're hitting them over the head and you're the police and they just will, they'll not engage with you.

P20: [. . .] So I would like to engage with people like more individually so to provide more like targeted advice and guide them and maybe explain more what could go wrong if they don't go this way.

Theme 3: Enhancing the RI promotion and implementation – necessary changes and steps toward improvements

The third theme that developed from the interviews focuses on improvements in the approach to RI. The participants provided numerous

suggestions on overcoming the existing challenges related to the development and implementation of RI guidance documents and practices. They reflected on the potential initiatives and stakeholders' roles in translating these initiatives into practice. In general, they agreed that having step-by-step RI guidance would be beneficial for fostering and promoting RI. However, they emphasized the importance of general RI guidance as a basis for developing more specific ones. Thus, the participants suggested that the best option would have to be a combination of general, aspirational RI guidance documents and more detailed tools, as they complement one another.

> P19: I think that codes that are general are needed. Cause they're foundational and they have the principles. But they don't have the steps. And I think you need the foundation and then the actual steps. And hopefully they don't contradict.

> P1: I would say that there should be a general code of conduct that should at least have the main points explicit and then maybe direct readers to different documents.

Additionally, some participants gave examples of RI-related issues for which they thought there was currently not sufficient guidance and for which it would be good to have step-by-step guidance to ensure high quality of performed research. These include SOPs for submitting research grant proposals and SOPs for funders on how to assess grant applications.

> P20: So I think that maybe some SOPs for the small funders will be something you might need to consider.

> P12: There should be SOPs when people apply for funding or there should be SOPs when you assess application [. . .].

However, the same participant also expressed skepticism whether SOPs for funders would be feasible, and mentioned that funders usually have guidelines and recommendations but not very strict and detailed SOPs.

> P12: [. . .] but in RFOs I do not know how you could have very strict SOPs. You can have guidelines, recommendations, you could check . . . I do not think SOPs . . . can be implemented in RFOs.

When it comes to developing new RI guidance documents, the participants emphasized the importance of researchers' involvement in creating these. Researchers must first perceive RI guidance documents as important and relevant in order to adhere to them. According to the participants, a step toward achieving this in the future is to have researchers more engaged in creating RI guidance documents, which is currently not always the case.

> P2: I think that if it's well known from the start, that the researchers themselves are actually involved in writing them, that will send a positive message to the institution that these just didn't come from the dean or the rector and we're throwing

> these on you. So I think that's a really good place to start. [...] You've gotta have some scientists involved on the team but you also have to have professional, true ethicists. [...] So, I think those are key players in building documents, whether it's a code of ethics or SOP.

> P4: And there's perhaps another thing and that is, that it may be good and useful to include and engage the researchers in the creation of SOPs themselves. [...] So that they can feel, feel that they contributed to developing that and that they can ensure that it's, that they're developed in a way that is relevant for them.

In addition, the participants pointed out the importance of support from research organizations, like more financial and resource support that is often needed to create and implement new policies and procedures.

> P14: There must be institutional support because without staff or without funding, we reach a certain point of implementation. So, there must be support at an institutional and formal level of recognition, but this is not enough if there is not a strong personal motivation and therefore the two aspects must always be together because one supports the other.

> P4: At central level organizations or bodies can perhaps facilitate, provide some support for that, encourage that, provide, I don't know, perhaps special expert teams to help with this process, or some funding if possible.

Besides financial support for implementing policies and procedures, the participants mentioned other initiatives that research organizations should introduce to incentivize the implementation RI practices. These incentives were also considered as facilitators of positive changes in the research culture and included awards for excellence in RI, and especially the shift in research evaluation from quantitative metrics to quality indicators.

> P23: And personally I think that institutions by only setting a few examples can already make a huge difference. They only award with the few examples and say hey we, we promote or we make this person a professor because he or she has excellent work in doing research in responsible way and … yeah, promoting responsible and reproducible research.

> P8: [...] I think probably the most important thing is start to change the way you evaluate the scientists. At least to give a sign that quantity is not all.

> P18: [...] As researchers, yes, it's your duty to publish but it shouldn't be your duty to publish in high impact factor journals. [...] So I think the incentive shipped from the institution should be publish a good quality research.

Furthermore, the participants emphasized the importance of RI bodies for the development and implementation of RI guidance documents and practices. The RI bodies should be set up in research organizations to oversee and handle RI issues. The participants mentioned that some organizations already have these bodies and their role in the future could be to develop SOPs for RI.

P19: In many institutions there is a research integrity officer. Who hopefully has control over that. And can help assess if there're inconsistencies in guidance or SOPs.

In addition to research organizations' roles, the participants also discussed the role of the funding organizations and scientific journals. The influence of funders on RI implementation is, in the participants' opinion, very important because they provide money for research, and they have the power to impose RI requirements. The participants suggested that the way funding organizations can foster RI is developing their own RI guidance documents and requirements for research performing organizations.

P23: The funder has the money. So the funder can force things by putting money or refusing to pay money.

P18: I think maybe with funders they could do more to follow up. So that the outcome of the funding isn't just this publication at the end or two or three publications at the end.

P11: [...] for sure they have an impact in the sense that they could force the applicant and as well as the institution, submitting to get funding just to have something.

As for the role of scientific journals in fostering RI, the participants most often mentioned the importance of retracting articles based on fraudulent research. However, the participants suggested that journals should take more responsibility regarding RI and be more transparent how they handle retractions, especially in regard to clear identification of retracted articles and access to information about corrections to the published record.

P18: [...] I think there are different views on how much responsibility the publisher has. Some publishers will say oh you know it's, it's up to the authors and the research community. But I think we now have enough examples to be honest to go no, we definitely need to sit up and to take some responsibility ourselves. [...] So from the publisher's side the main thing we can do is retract and answer them. And when we're retracting we also have to be clear why are we retracting.

P19: [...] Then a journal has a responsibility to retract that article and to make that public. And to make that retraction public. Not behind a paywall. And to make sure that the retracted article is properly labelled and watermarked do not use. And so that's where journals can help make that public.

Discussion

Our study showed that researchers and other stakeholders with expertise and experience in RI do not see SOPs as currently common RI guidance documents, but they consider them as valuable for fostering and promoting RI. However, this was not without expressing the skepticism toward having

a large number of very detailed RI guidance documents. In their opinion, SOPs and other specific, step-by-step guidance must be combined with general guidance containing fundamental and aspirational RI principles. RI guidance documents and practices adjusted to researchers' needs and their implementation through RI education and stakeholders' support are essential for fostering RI. The main challenges that need to be addressed in the future, to achieve the improvements regarding the implementation of RI and RI guidance documents and practices, include harmonizing approaches to RI issues, including researchers in the development of RI guidance documents, developing incentives and evaluation practices based on the RI requirements and engaging funders and scientific publishers to take more responsibility in addressing RI issues.

The study participants expressed concerns regarding the lack of standardized and harmonized approaches to RI. The participants in our study focused on the absence of conceptual harmonization in terms of how research misconduct and other poor research practices should be understood. And although RI entails more than research misconduct, one of the reasons why the participants in our study focused solely on the research misconduct could be because lack of harmonization and different interpretations on what is considered as poor research behavior leads to different applications of fundamental RI principles and different consequences for researchers. This is not in agreement with considering RI as a global endeavor in which the whole research community should strive to equal, highest standards of RI for producing trustworthy, reliable, and reproducible research. In the participants' opinion, not having a standardized approach to these issues in a wider community affects RI implementation at the place where research is performed – at research organizations. The harmonization issue has been intensively discussed in the research community for some time (Mayer and Steneck 2007; Horbach and Halffman 2017; NASEM 2017). In Europe, where some harmonization could be expected within the European Union and under the framework outlined in the European Code of Conduct for RI (ALLEA 2017), there is a high level of diversity between research organizations and their definitions on what behavior is qualified as research misconduct (Godecharle, Nemery, and Dierickx 2014; Aubert Bonn, Godecharle, and Dierickx 2017; Desmond and Dierickx 2021). However, Europe is not the only one fighting the harmonization challenges as the problem goes beyond a single geographical location and harmonization issues pervade the global research system and research organizations operating in the system (Resnik et al. 2015; Resnik, Rasmussen, and Kissling 2015; NASEM 2017; Yi, Nemery, and Dierickx 2019; Li and Cornelis 2020). Despite recent discussions aimed at revising poor research practices commonly labeled as research misconduct, i.e., fabrication, falsification, and plagiarism (FFP) (Resnik 2019), research showed that FFP are well known around the globe and an

integral part of many organizational RI and research misconduct policies. However, there is a diversity that goes beyond FFP, and a gray zone exist when it comes to other misconduct, questionable/detrimental research practices and sloppy science which are often seen as major harmonization challenge (Resnik, Rasmussen, and Kissling 2015; Resnik et al. 2015; Bouter et al. 2016; Bouter 2020; Li and Cornelis 2020). This could also be another reason why the participants focused solely on harmonization challenges related to research misconduct. They maybe see it as a starting point toward harmonization in RI. We need adequately defined basic concepts to create more specific guidance on avoiding poor research behavior and encouraging good research practices. In that context, some research has argued whether having properly defined good research practices and adherence to those practices may reduce or diminish the occurrence of research misconduct (Kalichman 2020). And if we take into account that compliance with guidance influences behavior (Tomić, Buljan, and Marušić 2021), we may ask ourselves questions such as whether the research community needs to define research misconduct and other poor research practices and achieve absolute harmonization. Or perhaps these could be more simply captured by defining them as practices that don't meet the principles of RI, which could help the research community harmonize better since there would be fewer terms and definitions. While it may be too optimistic and perhaps not feasible to achieve harmonization on every RI issue because it is important to consider local contexts (for example, disciplinary field characteristics or research organizations' needs), we would argue that harmonizing as much as possible should be something to strive for. Although having fewer definitions could help harmonization, we believe that by defining sloppy science and poor research behavior merely as "practices that do not meet the principles of RI" we risk having a variety of interpretations and explanations about why something is or is not considered as a poor research behavior. Perhaps the first step toward better harmonization should be to agree on behavior considered as research misconduct and questionable/detrimental research practices. The second step should include research organizations integrating the developed definitions into their RI guidance documents. And finally, the third step should include research organizations developing more detailed oriented guidance documents, for example, SOPs, on how to avoid poor research behavior and harmonize these documents and RI practices at least in the same disciplinary field. This means developing step-by-step guidance for different RI topics (for example, authorship or data management), tailored to the needs and specifics of the disciplinary field that will ensure uniform approaches to RI issues among researchers working in the same disciplinary field.

When asked about the SOPs for RI, the participants named different guidance documents as SOPs (reporting and other guidelines, codes of

conduct, checklists, and flowcharts). Based on discussions, we noticed that SOPs perhaps are not so common in the RI field since the participants were not very familiar with documents called SOPs for RI. Besides that, the participants had a different understanding of what is considered to be an SOP. While some considered as SOPs only the documents that had SOP in the title, others considered SOPs to be different types of guidance documents that were, in their opinion, detailed enough to fit the formal definition of SOPs or that were standards in the RI field. However, this is not unusual if we take into account results from other studies that showed there are no strict rules regarding how guidance (e.g., general or specific, aspirational or normative) is presented in different types of guidance documents (Desmond and Dierickx 2021; Ščepanović et al. 2021). The participants most often mentioned reporting guidelines as SOPs. Although called guidelines, reporting guidelines could fit into the definition of SOPs as a tool to achieve uniformity, transparency, and high quality of performing specific tasks. The value of reporting guidelines is in helping researchers in publishing the minimum amount of information about a study that is required for its critical assessment and inclusion in evidence synthesis, thus contributing to the completeness and transparency of research output and the reproducibility of research results (Simera et al. 2009; Moher 2018). This corresponds to the definition of steps in SOPs that should be done in certain processes and responsibilities of those involved in the process so that the same action is performed in the same manner each time and that the quality of output is ensured (Barbosa et al. 2011; Akyar 2012). However, the important difference between any guidelines and SOPs is that guidelines often are not mandatory to adhere to, while SOPs are usually developed and implemented by organizations and compulsory for the organization's members. The result of the non-obligatory nature of reporting guidelines is visible in the effectiveness of its implementation: while they have improved the transparency and completeness of research reporting in health (Turner et al. 2012), these effects are still suboptimal, mostly because they are implemented by journals only formally, without a clear explanation of their importance and instructions on how to use them to achieve their goal (Hirst and Altman 2012; Sims et al. 2016). Besides reporting guidelines, other examples of RI guidance documents could be considered as SOPs for RI, although not explicitly called an SOP. For example, the Australian Guide to Managing and Investigating Potential Breaches of the Australian Code for the Responsible Conduct of Research (NHMRC 2018b) provides enough details and could be considered an SOP for research organizations. The guide sets the model which institutions should follow in the cases of breaches of the Code, describes the roles and responsibilities of different bodies, and provides checklists with defined tasks. Unlike reporting guidelines, the guide is mandatory for research organizations, although it leaves a certain level of freedom for organizations

to tailor the model to the needs of legal framework, processes, and agreements established in the workplace. Similarly, although allowing implementation flexibility, the UK Self-Assessment Tool for The Concordat to Support RI (UKRIO 2021) provides comprehensive guidance to help research organizations and researchers put high-level RI statements into practice. The tool contains self-assessment questions and checklists addressing different RI topics, thus providing a step-by-step guidance in dealing with different RI issues. The participants also mentioned codes of conduct and general guidelines, such as the European Code of Conduct for RI (ALLEA 2017) and Singapore statement (Singapore Statement on Research Integrity 2010; Resnik and Shamoo 2011) as examples of SOPs, although these documents are very general and aspirational and cannot be considered as SOPs. However, it is important to emphasize that principle-based or more general guidance documents, although often lacking details in addressing RI, have broad applicability across different research disciplines. On the other hand, more detailed documents, such as SOPs, provide comprehensive guidance on performing research with integrity. However, because of their specific guidance, they may not be universally applicable but rather focused on a certain disciplinary field, research organization or research process. The participants in our study mostly expressed a positive attitude toward developing SOPs to promote RI and help researchers avoid sloppy science. However, they stressed that SOPs could not stand alone, and they have to be embedded in more general, aspirational guidance documents that present values and principles as opposed to rules. Hence, the participants concluded that for RI promotion, it is necessary to have both general and step-by-step guidance that should be consistent and should not contradict each other. The broad guidance will help researchers better understand the value and importance of RI and should serve as a basis for developing more specific RI practices. Although there is no official policy framework or hierarchy for guidance documents in the RI field, the need for coexistence of general and detailed RI guidance is perhaps already evident from some initiatives, such as by the European Commission. For example, Horizon Europe applicants are required to make mandatory declarations, including the declaration that the research proposal complies with RI practices set out in the European Code of Conduct for RI (European Commission 2021). Thus, the Code has been implemented as a "soft law" in grant agreements. Moreover, applicants must also confirm that they have "appropriate procedures, policies, and structures in place" to ensure compliance with the Code and handle its breaches. SOPs could be such specific procedures and policies that will enable the institutional implementation of the principles and good practices addressed in the Code and ensure compliance and handling of the breaches.

It is also important to say that participants in our study expressed concerns that developing detailed guidance documents for different RI issues

inevitably brings resourcing and governance challenges. Developing detail-oriented guidance documents, like SOPs, for different RI issues and updating and revising these documents regularly to ensure their quality and applicability would require continual financial and human resources. This may be an issue for some research organizations as not all of them have the same opportunities and resources. However, we believe that RI is not only important for the research community but also has wider implications and is important for the society that relies on research findings. Because of the importance of producing honest, reliable, and reproducible research results, research organizations should invest at least some resources in developing and implementing RI documents that could help standardize approaches to RI, such as SOPs. This would require some balancing by research organizations and deciding which RI issues are to be prioritized and hence which RI issues require more detailed guidance in their setting. Moreover, research organizations do not have to start from scratch since different guidance documents are already available. They could adapt them to their needs, saving time and resources needed to be invested in developing these documents. Besides resourcing and governance challenges, the participants emphasized other issues that should be taken into account to achieve better applicability of RI guidance documents and practices. RI guidance documents should be understandable and close to practice so that researchers will perceive them as relevant and be willing to use them in their everyday work. This is important because compliance with written policies influences virtuous behavior, further encouraging the promotion and implementation of RI (Tomić, Buljan, and Marušić 2021). However, if researchers do not perceive RI guidance documents as relevant to their research, they may create negative perception of RI and decline to use them, i.e. treat them as an administrative burden outside of the research process. Examples of researchers avoiding using guidance documents because they lacked flexibility and connection with real-life situations have been documented (Giorgini et al. 2015; Davies 2019). Moreover, the literature shows great diversity between how researchers and policymakers who create and implement RI guidance documents understand RI, leading to the obstruction of norms by researchers (Horbach and Halffman 2017). The inclusion of researchers in developing RI guidance documents was considered by the participants as the only way to ensure that RI guidance documents and practices are adjusted to researchers' needs and hence actually implemented in research. Besides the increased involvement of researchers in developing RI guidance documents, RI education was emphasized as an essential requisite for RI promotion and implementation of RI practices. The participants referred to RI as a state of mind (P4: Research integrity is about the state of mind. You know, it's about an attitude.) which includes an internalized understanding of RI principles and values in the RI guidance documents and willingness to adhere to those,

which can be acquired through continuous and tailored to the needs education. However, the available evidence considering the effectiveness of RI education is rather contradictory. Meta-analysis and systemic reviews showed the lack of evidence to support the claims on the positive effect of RI education on shaping researchers behavior, while qualitative research showed that RI education helps to raise researchers' awareness and to motivate them to think more about RI issues in their research (McGee et al. 2008; Marusic et al. 2016; Mumford 2017; Olesen et al. 2019). These discrepancies may be related to the high number of different educational approaches to RI and ethics training (Mumford 2017; Pizzolato, Abdi, and Dierickx 2020). Nevertheless, the participants in our study think that one size does not fit all RI needs, and that RI education and RI guidance should be carefully planned and developed to fit the researcher's needs and the needs of disciplinary fields. Besides that, the participants advocated for more interactive courses in smaller groups and use of real-life examples followed by researchers' reflection and evaluation.

The participants emphasized the equality of the importance for the role of researchers and other stakeholders in research in promoting RI practices and creating the environment in which RI principles and values will be followed. However, stakeholders in RI are not always aware of their responsibilities. They often see the RI as the sole responsibility of researchers and RI policies as something that is not an integral part of their organizational structure (NASEM 2017). Although there are successful RI initiatives (Bouter 2020; Mejlgaard et al. 2020), our study participants strongly advocated for more changes and improvements to promote RI. The establishment of RI bodies in research organizations was one of the often mentioned initiatives. RI officers or other RI bodies should be the first contact point for researchers regarding RI, and their responsibility is to receive and resolve RI issues within the organization. The information on the existence of bodies dedicated to RI in research organizations in different countries is scarce (Maisonneuve 2019; Marušić 2019), which may indicate the lack of commitment in this area. However, there are examples of research organizations that have successfully established bodies specialized for RI (Lerouge and Hol 2020), as well as guidance for setting up RI bodies and defining competencies and skills of its members (ENERI, ENRIO, and OeAWI 2019; Braun, Ravn, and Frankus 2020). Besides setting up RI bodies, the participants emphasized the need for changes in evaluation metrics, which should be shifted from quantitative to qualitative and include RI compliance. Currently existing evaluation and incentives systems in academia are often seen as factors encouraging poor research behavior since they contribute to creating unhealthy research culture and over-competitive environment dominated by the pressure to publish (Fanelli and Scalas 2010; Sarewitz 2016; Lindner, Torralba, and Khan 2018). Although these issues are an old problem – there are studies from the 1980s

and 1990s addressing the problems of pressure to succeed in a career, pressure to publish and to obtain tenure (Petersdorf 1989; NAS, NAE, and IOM 1992) – it seems that research community still has to find the solution to these problems to preserve responsible conduct of research. Initiatives like the Leiden Manifesto for research metrics (Hicks et al. 2015), San Francisco Declaration on Research Assessment (DORA 2021), the Hong Kong Principles for assessing researchers (Moher et al. 2020), and Science Europe Recommendations on Research Assessment Process (Science Europe 2020) can help to achieve this aim.

Research organizations do not operate alone in this research ecosystem (Hermerén et al. 2019) so funding organizations and scientific journals are important stakeholders in strengthening RI promotion in research organizations. The participants in our study advocated for more involvement of these stakeholders in promoting RI. There are already examples of positive initiatives, such as previously mentioned policies from the EU Horizon program that will require research organizations to declare having clear policies in place as a prerequisite to obtaining funding (European Commission 2021). In addition to the requirements for obtaining funding, our study participants also emphasized the need for more post-research evaluation by funders, which should include, among other factors, the adherence to RI requirements. The participants in our study asked for a greater role of scientific journals and publishers in promoting RI, primarily by ensuring the integrity of the published record, particularly timely and clearly visible retraction of fraudulent research and correction of published errors. Although there is evidence that some scientific journals have well-implemented retraction policies and procedures (Resnik, Rasmussen, and Kissling 2015; Marasović, Utrobičić, and Marušić 2018), the participants in our study were concerned about the fact that many retractions often may go unnoticed because journals either do not want or do not have resources to adequately correct the literature, as has been shown in several cases (Trikalinos, Evangelou, and Ioannidis 2008; Wiwanitkit 2016). Besides publication retractions, other important initiatives from journals help promote RI and improve researchers' adherence to RI practices. For example, the authorship contribution statements mandated by journals enable higher transparency, integrity, and accountability of individual contributions and help avoid or reduce potential authorship disputes. Further, open access and data practices are today implemented by more and more journals – they increase the visibility and transparency of research, but also provide more opportunities for verification and reproducibility of research results. There are also efforts to improve the collaboration between the scientific journals and research organizations on fostering RI and preventing research misconduct (Wager and Kleinert 2021).

Strengths and limitations

To the best of our knowledge, this is the first study exploring the role for SOPs in RI and their potential in fostering and promoting RI. The main strength of our study is the inclusion of participants from different stakeholders' groups and from various countries and disciplinary fields, who all had experience working in the RI and RE. This enabled us to obtain knowledge on various approaches to RI and collect information on existing issues and ideas for improvements. According to the literature, small qualitative studies usually comprise 6–10 interviews, while big qualitative studies are considered those with 20 and more conducted interviews (Braun and Clarke 2013). Hence, we believe that our study collected thorough and sufficient information related to the study aim and research questions. The possible limitation of our study is a small representation of members of funding organizations, who we were not able to recruit in bigger numbers despite our efforts. Because of this, we were not able to explore RI guidance documents, including SOPs, in funding organizations which was one of our study's objectives. Moreover, this could also mean that we did not get a detailed insight into how research funders deal with RI issues and how they organize internal RI structures and processes. However, we were still able to obtain information on funders' initiatives known to the research community and participants were able to identify issues that funders need to address in future.

Conclusion

RI is a global endeavor, and researchers are responsible, along with research organizations, funders, and publishers, for developing and preserving the culture of integrity. In the participant's words: "The rotten apples are the result of an unhealthy garden. To reduce the number of rotten apples, we must develop a healthy research culture". The research community should strive to harmonize fundamental RI principles, concepts, and definitions in order to improve RI practices and prevent research misconduct. Developing detailed-oriented RI guidance documents, such as SOPs, would also be beneficial in ensuring some level of uniformity and standardization, but such specific, step-by-step RI procedures should be developed in cooperation with researchers and adjusted to their needs, to ensure their relevancy and successful implementation.

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Protocol registration

The protocol was registered at the Open Science Framework (OSF) on 11 April 2019. The registration is part of the SOPs4RI project WP3 component (Systematic reviews of practices and research cultures) registration (available at https://osf.io/saj4u). The protocol is available at https://osf.io/srzup/.

Data availability statement

Interview guide, examples of information letter, informed consent document and demographic questionnaire are available in Appendices. Audio recordings and their transcripts are not available to ensure the privacy and confidentiality of participants' data.

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Appendices

Appendix1: Interview guide

Original version (pilot interview)

First, I would like to thank you for accepting our invitation to participate in this interview. As it was mentioned in the invitation letter, this interview will be conducted as a part of the *Horizon 2020 project SOPs4RI (Standard Operating Procedures for Research Integrity)*. The aim of the project is to create an online toolbox consisting of SOPs and guidelines for the promotion of research integrity in research performing organisations (RPOs) and research funding organisation (RFOs). These SOPs and guidelines will be offered as flexible tools for RPOs and RFOs to develop Research Integrity Promotion Plans.

To be able to create a toolbox containing best practices for RI,, in this interview we would like to hear your experience with practices for the promotion of research integrity and their implementation within research organizations. Further, we would like to hear your opinion regarding the influence of research culture and thoughts about research misconduct. I would like to point out that there are no right or wrong answers so please feel comfortable to express your opinion. Your opinion is very valuable to us and will contribute to the further development and the goal of the project. This interview is confidential; hence everything said will be used, as mentioned in the invitation letter, only for the purposes of the SOPs4RI project.

During the interview, I will take notes and the conversation will be recorded. The recording is only to ensure we have all your answers. As we stated in the invitation letter the tapes will be stored for the period of five years after the last publication.

Do you agree for this interview to be tape-recorded?

This interview will last about an hour. If you don't have any additional questions we can start the interview.

1) Can you briefly tell us what behavior you consider as responsible research conduct and what practices can help researchers to adhere to research integrity and responsible research conduct?

Possible probes:

How can those practices be implemented into research institutions?

How important is for the institution to develop and enforce rules which will be assembled as codes, guidelines and SOPs, and in which good and bad research practices will be described?

In your opinion, should codes, guidelines, and SOPs be optional or mandatory for research institutions and whether researchers should be obligated to adhere to those norms?

2) What would you address as prominent reasons why researchers get involved in research misconduct?

Possible probes:

Is research culture sufficiently detailed and what other practices, other than FFP, would you consider a violation of research integrity and which need to be regulated?

How are factors such as publishing, obtaining funding for research, career perspectives, and the behavior of supervisors influencing researchers to involve in research misconduct?

3) What would you address as the most important practices for avoiding research misconduct and what can be done by RPOs and RFOs to avoid research misconduct?

Possible probes:

How important is the training of PhD students and their mentors?

In which way research integrity committees should deal with research misconduct?

What do you think about rehabilitation exercises for researchers involved in research misconduct?

How can funding agencies and journals contribute to the avoiding of research misconduct?

4) Which elements of research culture may have an impact on the implementation of RI practices (positive or negative) and what changes within research culture would be desirable?

Possible probes:

Would publishing negative research results have any impact on the reducement of cases of research misconduct?

What are the pros and cons of temporary and permanent job contracts in terms of conducting research and the researcher's career?

Revised interview guide and questions

First, I would like to thank you for accepting our invitation to participate in this interview. As it was mentioned in the invitation letter, this interview will be conducted as a part of the Horizon 2020 project SOPs4RI (Standard Operating Procedures for Research Integrity). The aim of the project is to create an online toolbox consisting of SOPs and guidelines for the promotion of research integrity in research performing organisations (RPOs) and research funding organisation (RFOs). These SOPs and guidelines will be offered as flexible tools for RPOs and RFOs to develop Research Integrity Promotion Plans.

To be able to create a toolbox containing best practices for RI, in this interview we would like to hear your experience with practices for the promotion of research integrity and their implementation within research organizations. The word 'practice' refers to SOPs, guidelines, codes of conduct, charters, checklists, procedures, and policies for research integrity, as well as training methods and education for research integrity and procedures to deal with research misconduct. Further, we would appreciate your opinion regarding the influence of research culture on the implementation of RI practices. The research culture in this context refers to factors as overall quality assurance/peer review system, trends in research funding, national

science and 'RI' policy, science culture, and concepts such as 'academic capitalism', 'publish or perish culture', 'accelerated academies', 'mode II'.

I want to point out that there are no right or wrong answers so please feel comfortable to express your opinion. Your opinion is very valuable to us and will contribute to the further development and the goal of the project. This interview is confidential; hence everything said will be used, as mentioned in the invitation letter, only for the purposes of the SOPs4RIproject. During the interview, I will take notes, and the conversation will be recorded. The recording is only to ensure we have all your answers. As we stated in the invitation letter, the tapes will be stored for a period of five years after the last publication.

Do you agree for this interview to be tape-recorded?

This interview will last about an hour. If you don't have any additional questions, we can start the interview.

A) Standard Operating Procedures

1. Of the existing practices (SOPs), in the area of research integrity and research ethics, you currently know, which of those practices do you consider useful and universally applicable (among different countries, different scientific fields and different research institutions)?

2. Besides the SOPs you mention, do you know of some innovative SOPs connected with your area of work?

3. Are there SOPs that need to be developed? Do you know of SOPs and practices that are needed but are either not developed or are insufficiently developed?

B) Research culture

1. In your experience, which elements of research culture may have an impact (positive or negative) on the implementation of SOPs? Are there any differences related to research culture between RPOs and RFOs?

2. In your opinion, what determines the successful implementation of SOPs?

3. What should be taken into consideration for successful implementation at the level of an organization and the level of an individual?

4. Are there differences in implementing SOPs between RPOs and RFOs?

Appendix2: Information letter, informed consent and questionnaire for interviews

Invitation to participate in the interview and informed consent for the stakeholder consultation

Standard Operating Procedures for Research Integrity (SOPs4RI)

Dear Sir/Madam,

The Horizon 2020 project SOPs4RIaims to contribute to the promotion of excellent research and a strong research integrity culture aligned with the principles and norms of the European Code of Conduct for Research Integrity (ALLEA (All European Academies) 2017). We at the SOPs4RIproject aim to collect existing standard operating procedures and guidelines and to develop them further for the implementation in research performing organisations and research funding organisations across Europe.We will create an online toolbox taking into account differences between disciplines and countries. The toolbox will present key elements, i.e. standard operating procedures and guidelines, which will help research performing organisations and research funding organisations create their own institution-tailored Research Integrity Promotion Plans (RIPP).

We would like to invite you to participate in this stakeholder consultation via participation in the interview. By agreeing, you commit to participating in the face to face or online interview (depending on your schedule and availability). As this is a Europe-wide consultation, the language of the interview will be English. The interviews will be conducted anytime from March to June.

Hereafter you can read details about the project and the stakeholder consultation so you can make an informed decision whether you would like to participate in the interview or not.

1. The aim of the research

To create aa toolbox of standard operating procedures and guidelines for Research Integrity Promotion Plans it is important to gain a better understanding of existing professional rules, practices, and factors influencing their implementation. The interviews with experts in the field of research integrity will provide us with additional knowledge on general elements for fostering research integrity in research performing organizations and research funding organizations. In this interview, we would like to hear your experience regarding practices for the promotion of research integrity and their implementation within research organizations. Further, we would like to hear your opinion regarding the influence of research culture and thoughts about research misconduct. Knowledge gained through the interviews, together with previously conducted literature search, will be used as a basis for the further development of the project and the discussion for the Delphi survey and focus groups. Ultimately, the knowledge gained in this project will be used for the development of the toolbox, consisting of standard operating procedures and guidelines, which can be applied among different academic disciplines.

2. What do we ask from you?

If you would like to participate, the interview will be conducted by the researcher from the *[name of the institution]*. The estimated duration of the interview is up to 1 hour. Before attending the interview, we will ask you to complete a brief questionnaire (sent via e-mail beforehand) about your background: gender, age, role regarding research integrity, years of experience, nationality and country of residence. The questionnaire will also include a couple of open questions about SOPs for research integrity. You can bring the printed survey answers to the interview or fill them in before the interview. If you decide to participate in the online interview, we kindly ask you to send us a filled survey via e-mail.

3. Benefits and risks of participating

Interviews with research integrity experts are essential for the development of the framework for the SOPs4RIproject which will enable us to build a toolbox with SOPs and guidelines for the promotion of research integrity. . This will help research performing organizations and research funding organizations to create plans with details to foster and promote responsible research practices, avoid detrimental practices and handle misconduct. Thus, by sharing your knowledge and experience you will help us contribute to the development of better science. The risk associated with the interview is that participants may feel uncomfortable to discuss research misconduct and express opinion about possible negative factors influencing implementation of research integrity practices.

To avoid possible risks we would like to point out that information provided during the interview are confidential. Moreover, if you would like to provide an example of research misconduct we advise you not to mention personal information or personal names but rather present an anonymous case. This way the cases presented in the interview will not be directly linked with the specific organization or individuals.

Your personal data provided during the interview will be anonymized in the course of the transcription process. The information provided during the interview will not be linked with

a specific participant. The information will be connected only with the type of stakeholder (researcher, member of the RI committee, funding and process organizations employee, policy-makers or industry employee).

The information provided during the interview will be used only for the purposes of the SOPs4RI project.

4. If you decide not to participate or to withdraw from the interview

Participation in the interview is voluntary. If you decide to participate, we kindly ask you to sign the attached informed consent and return it to us via the e-mail. If you have agreed to participate but change your mind, you can withdraw at any point (including during the interview). When you withdraw from the study, all your non-anonymized data will be destroyed. If your data has already been analyzed, the results will be used but the source of the data will not be retrievable.

5. Data processing and storage

Storage and use of the data collected during the interview will be in alignment with the data protection procedures contained in the European Union Law, specifically Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation – applicable as of 25 May 2018 in all European Union member states) and Danish Ministry of Higher Education and Science's recommendation in the Danish Code of Conduct for Research Integrity - Section II. 2. 1. i. (https://ufm.dk/en/publications/2014/the-danish-code-of-conduct-for-research-integrity)[. All data collected through the interviews will be stored on the SharePoint, a web-based collaborative platform, administered by the project coordinator, i.e. AarhusUniversity. The access to the stored data will be enabled only for the partners of the SOPs4RIconsortium.

The ethics approval for conducting all interviews in the Work Package 3 has been obtained by the Ethics Committee at the University University of Split School of Medicine. If you decide to participate in the online interview, we would like to point out that the Skype Business platform is GDPR compliant. All collected data will be stored for a period of five years after the last publication. This includes original audio-visual files, transcriptions, signed consent forms and questionnaires. Only anonymized data will be used for analysis.

In line with the open access movement, we will make the anonymized data publicly available on the Open Science Framework. If we notice that there is any data that even after anonymization has the potential to be sensitive, we will send it to you to obtain consent to either deleting it, anonymizing it further or making it publicly accessible. If you would like to have access to your non-anonymized data (stored encrypted on SharePoint), you can always contact *[name and e-mail address of the researcher]* to have it sent to you. The findings from the stakeholder consultation will also be published and made publicly available on the Project's page on the https://cordis.europa.eu/en.

6. Financial aspects

There is no fee paid for participation in the study.

7. Do you have any questions?

Please do not hesitate to contact, Prof. Ana Marušić, MD, PhD, ana.marusic@mefst.hr, if you have any questions.

If you would like to contact Data Protection Officer at the University of Split School of Medicinefor additional information regarding data protection, privacy issues, and use of data in this research please use this address: dpo@mefst.hr.

Informed consent and confidentiality agreement

Please read the statements below in connection with the research 'Standard Operating Procedures for Research Integrity (SOPs4RI): stakeholder consultation – interviews': stakeholder consultation – interviews'. By signing the consent, you indicate you are in the agreement with all of the statements below.

- I have read the information provided about the study. I had the opportunity to ask questions and my questions have been sufficiently answered. I have had enough time to decide whether I would like to participate.

-I am aware that participation in the study is voluntary. I also know that I can decide at any moment to not participate or withdraw from the study. I do not have to provide any reasons for not participating or terminating enrollment in the study.

- I give consent to the audio recording of the interview (and video recording for online interview).

- I give consent to the collection and use of my data as described in the information sheet. I give consent to having my data stored for five years on SharePoint after the study has been completed.

- I give consent to having my anonymized data publicly available. I understand that this means that the anonymized data can be used for research purposes other than the ones described in the information sheet. I am also aware that this means that my anonymized information may be used in countries outside of Europe and that the regulations for data processing and storage in those countries may not comply with those of the European Union.

- I want to participate in this study.

Name:

Signature:Date: __/__/__

Questionnaire

As stated in the invitation letter, this questionnaire is a part of the SOPs4RI*[Withheld for blind review* project task related to the expert interviews. The questions address your demographic data (gender, age, nationality and country of residence) and questions concerning information relevant for research integrity and standard operating procedures (SOPs).

Storage and use of the personal data collected through the questionnaire will be in alignment with the data protection procedures stated in the invitation letter.

Your age (in years): _____

Your gender: a) Male b) Female c) Prefer not to say

Country of residence: _____

1. How are you involved in research?

a) Researcher/educator

b) Member of research integrity committee

c) Funding and process organizations

d) Policymaker

e) Industry

2. Years of work experience related to research integrity: _____

3. Can you specify 3 characteristics of SOPs that are, in your opinion, crucial for their quality? (e.g. if SOPs should be clear, detailed, extensive, up to date, action-oriented etc.)

4. Can you give us an example of SOP containing characteristic you specified above and that is, in your opinion, an example of good SOP for research integrity?