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Study Registration for the Field of Prevention Science: Considering Options and Paths Forward

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Abstract
The practice of prospectively registering the details of intervention studies in a public database or registry is gaining momentum across disciplines as a strategy for increasing the transparency, credibility, and accessibility of study findings. In this article, we consider five registries that may be relevant for registration of intervention studies in the field of prevention science: ClinicalTrials.gov, the American Economic Association Registry of Randomized Controlled Trials (AEA RCT Registry), the Open Science Framework Preregistration (OSF Preregistration), the Registry for International Development Impact Evaluations (RIDIE), and the Registry of Efficacy and Effectiveness Studies (REES). We examine the five registries in terms of substantive focus, study designs, and contents of registry entries. We consider two paths forward for prospective registration of intervention studies in the field of prevention science: Path A: register all studies in ClinicalTrials.gov and Path B: allow individual researchers to select the registry with the "best fit." Lastly, we consider how the field might begin to establish norms around registration.

Keywords Registration · Transparency · Registry · Open science · Intervention studies

The field of prevention science aims to conduct high-quality science to inform strategies for improving the health and well-being of people through multiple means, including changes in behavior, physical environments, and health services, and informing the design and implementation of programs and policies (NIH, n.d.-a). Achieving a high-quality science ecosystem requires that scarce research dollars are channeled to studying priority issues, that study designs and methods are rigorous and well-matched to the problem, and that research findings are fully reported and accessible to policymakers, practitioners, and other researchers. Slippage at any stage of the research—from funding decisions through dissemination of findings—can jeopardize the usefulness of a study. Although improving all parts of the research ecosystem is critical, this paper emphasizes the practice of prospective registration, or registering the details of intervention studies in a public database or registry, to promote full reporting of studies and study findings because selective or incomplete reporting has raised concerns across the sciences regarding the comprehensiveness and trustworthiness of the evidence base (Dwan et al., 2013). The goal of the paper is to draw on the experiences of study registration in other fields of research to inform decisions about registration policies and platform designs that would work well for prevention science.

Selective or incomplete reporting may occur at the study or findings level and for a variety of reasons (Goodman et al., 2016; Lipsey & Wilson, 2001; Pigott et al., 2017; Sutton & Pigott, 2005; van der Steen et al., 2018). At the study level, selective reporting is when no findings from a study are reported. This is most likely to occur when a study has no positive, statistically significant findings (Franco et al., 2014). For example, suppose a study was conducted to test the effect of an intervention aimed at discouraging drug use among high schoolers. The study found no evidence that the intervention was effective and, rather than report this, the research team simply moved on to the next study. Failure to

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report on the study means its findings are excluded from the evidence base, leading to a potential bias in any evidence synthesis that would have included this study.

Selective or incomplete reporting of findings within a study may take different forms (Goodman et al., 2016; Norris el al., 2013; Pigott et al., 2013). For example, study authors may report only select outcomes, typically those with positive and statistically significant findings. Or they may report findings for only select subgroups or outcomes that have positive and/or statistically significant findings. Study authors may fail to report some or all primary outcomes in favor of secondary outcomes that show "better" effects. They also may report outcomes for post hoc exploratory analyses but without stating that the hypotheses were exploratory (also known as *HARKing*) (Kerr, 1998; Rubin, 2017). Or they may report outcomes that were achieved only after a large number and range of model combinations were tested before arriving at statistically significant findings (also known as *p-hacking*) (Brodeur et al., 2018; Gelman & Loken, 2013). More often than not, selective or incomplete reporting of studies or findings means that null and adverse findings are under-reported and, as a result, there is an upward bias in the share of reported findings that are positive (Mahoney, 1977; Robbins, 1968).

Minimizing selective or incomplete reporting of studies or findings is critical to the scientific enterprise. One approach for minimizing selective reporting of entire studies is to increase the transparency of studies, that is, to provide information about studies in the public domain so that all studies are easily found. A strategy to minimize selective or incomplete reporting of findings within a study is to make details about elements of the study design (e.g., outcomes, subgroups, analyses) available in the public sphere before the study commences. Making these details public before the study is conducted, often referred to as *prospective study registration*, holds researchers accountable for reporting all findings and for conducting the underlying analysis in a manner consistent with what was planned or for explaining why the plans were altered.

The field of medicine increased transparency and accountability in medical research through requiring prospective registration of clinical trials or interventional studies, as well as other types of studies, in a public database (Zarin et al., 2017). The most widely known and well-established database for registration of clinical trials in medicine is ClinicalTrials.gov. ClinicalTrials.gov was started in response to the Food and Drug Administration Modernization Act of 1997 (FDAMA). The FDAMA required the U.S. Department of Health and Human Services (HHS), via the National Institutes of Health (NIH), to create a registry of clinical trials. The registry included both federally and privately funded trials "conducted under investigational new drug applications to test the effectiveness of experimental drugs for serious or life-threatening diseases or conditions" (NIH, n.d.-b). In response, the NIH National Library of Medicine (NLM), with input from the Food and Drug Administration (FDA) and others, created the ClinicalTrials.gov website, which was open to the public in early 2000 (NIH, n.d.-c).

ClincialTrials.gov was created with two goals in mind. The first was to "establish a publicly accessible and searchable database for disseminating a minimum set of structured information about all ongoing and completed trials," and the second goal was to "provide access to date-stamped protocol amendments that occur during the trial" (Zarin et al., 2017, p. 386). To meet these goals, study authors must complete a prospective registration following a specific protocol that collects a set of information about the study and update the protocol as warranted during the study. The Food and Drug Administration Act of 2007 (FDAAA) pushed the role of ClinicalTrials.gov even further as it required certain clinical trials to also report summary results upon the conclusion of a trial. As a whole, registering studies, updating protocols, and publishing results will increase transparency and accountability.

Since the public launch of Clinical Trials.gov, study registration has gained momentum not only in the health sciences but also across other fields including but not limited to prevention science, education, economics, and psychology. As a result, multiple platforms for study registration now exist. The rise in the number of registries has resulted in ambiguity about where to register studies that cross disciplinary boundaries or public policy arenas, something that is common for studies in the field of prevention science. For example, prevention science addresses issues deriving from and affecting economic circumstances; educational contexts and outcomes; social context and social-emotional well-being; health and nutrition; and environmental context, health, and safety.

The purpose of this paper is to examine a set of registries that may be relevant for intervention studies in the field of prevention science. We begin by briefly defining *study registration.* We then introduce a set of registries that may be relevant for the field of prevention science. Next, we examine the registries in terms of their substantive focus, study designs they accommodate, and the specific contents of study registrations. Finally, we consider two paths forward for registering studies in the field of prevention science and how the field might begin to establish norms around registration.

Study Registration

A *study registry* is a database where researchers, often the principal investigators, provide information about their studies in the public sphere (Banks & McDaniel, 2011).

Submitting a study to the registry and making it public is often called *registering the study*. The timing of study registration, specifically whether it is prospective or retrospective, is important and is captured in registries.

The working definitions of *prospective* and *retrospective registration* differ slightly across registries. For example, a prospective registration may be defined as one that is completed and in the public domain before the first participant is enrolled or it may be defined as one completed before outcome data are collected. Across the social sciences, the term *pre-registration* is frequently used synonymously with *prospective registration* (Rice & Moher, 2019). A retrospective registration may be defined as one that occurred after the first participant is enrolled, after outcome data are collected, or after a study is completed. For the purposes of this paper, we consider a prospective registration as one completed and in the public domain prior to collection or analysis of outcome data and a retrospective registration as one completed and in the public domain after the start of data collection or analysis of outcome data.

In this paper, we focus only on prospective registration because it has the greatest potential to minimize the likelihood of selective or incomplete reporting of findings leading to bias in the evidence base (Nosek et al., 2018). Researchers are more accountable to full reporting of study findings when details related to the design and analysis plans have been prospectively posted in a public database. This is because prospective registration makes it possible for journal editors, reviewers, and other interested stakeholders to easily examine the completeness of reported findings.

Note that a prospective registration is different than a registered report (see Chambers, 2013; Reich et al., 2020 for more details on registered reports). A registered report is a format for journal articles in which authors submit a manuscript for review in two phases. The first phase is prior to conducting the study or analyzing the data, much like a prospective registration. However, unlike a prospective registration, it is in the form of a journal article and includes a full introduction, background, and methods section of the manuscript. It also includes the reference or link to the public prospective registration. Reviewers then assess the manuscript based on the importance of the study and quality of the methods. At that point, the manuscript may receive an in-principle acceptance, revise and resubmit, or rejection. An in-principle acceptance means that if the authors follow their proposed research plan, complete the study, and submit the full manuscript, then the manuscript will be accepted regardless of the direction or statistical significance of the findings.

Because studies often undergo changes, most registries time stamp original study registrations and encourage researchers to update registrations as plans change. These updates, which are also time stamped, provide an important narrative related to study changes. This complete history of a study registration and updates is important for study transparency and ultimate credibility and usefulness of the findings.

The information asked for in registries varies, but all registries require researchers to provide basic information about their studies. This includes the name and title of the principal investigators, the funder, the start date, the topic area, a description of the intervention, and a description of the sample. This type of basic information is critical for increasing transparency of studies and making it easier for researchers, policymakers, and the public to locate studies and access information about them.

In addition to basic study information, many registries ask for details related to the study design, the research questions/hypotheses or outcomes, and the analysis plan. The purpose of collecting this information is to provide documentation of the study goals and hold researchers accountable for complete reporting of findings.

Registry Options

In this paper, we focus specifically on registration of *intervention studies*, or studies that seek to generate evidence on the impact of interventions (e.g., a program, policy, or practice), as these are foundational studies in the field of prevention science. As noted above, we also focus specifically on prospective registration of studies.

Over the past 25 years, the number of registries available for intervention studies has greatly increased. As prevention science encompasses intervention studies across multiple domains including, but not limited to, health, mental health, education, exercise, and substance abuse, we sought to identify and explore high-profile registries geared toward intervention studies in these domains. We chose to explore the following five registries:

- ClinicalTrials.gov, the preeminent registry in the health sciences;
- American Economic Association Registry of Randomized Controlled Trials (AEA RCT Registry), the leading registry in economics and other social sciences;
- Open Science Framework Preregistration (OSF Preregistration), a registry that is widely used across psychology and the broader social sciences and is part of a larger movement for open science;
- Registry for International Development Impact Evaluations (RIDIE), a leading registry for social science intervention research in low- and middle-income countries; and
- Registry of Efficacy and Effectiveness Studies (REES), the sole registry to specifically focus on education and related intervention studies.

We next provide a brief description of each registry (see Table 1 for additional details).

ClinicalTrials.gov is the leading registry for health research. Released to the public in 2000, it is the longest-running registry of the five we examined. Although ClinicalTrials.gov includes observational studies as well as intervention studies, in this paper we focus on the registry's database of intervention studies, or clinical trials, that consider biomedical or health outcomes encompassing physical, psychological, and behavioral health. It includes studies both within and outside of the USA.

The AEA RCT Registry was launched in 2012. The design and implementation of the registry were a joint effort between the American Economic Association and the Abdul Latif Jameel Poverty Action Lab (J-PAL). The registry, which is maintained by J-PAL, targets intervention studies in economics and other social sciences. It includes studies both within and outside of the USA.

The OSF Preregistration portal launched in 2013. It is a stand-alone registry within the Center for Open Science's suite of registries and is one of the more commonly used OSF registries. The OSF Preregistration is agnostic with respect to substantive focus, study design, and location (e.g. within or outside of the USA).

The RIDIE was launched in 2013 by the International Initiative for Impact Evaluation (3ie) in partnership with the RAND Corporation. It is maintained by 3ie. The registry is geared toward intervention studies focused on development in low- and middle-income countries across a variety of domains including education, health, nutrition, and urban development.

REES, the newest registry of the five we examine, was launched in October of 2018. The registry was funded by the Institute of Education Sciences (IES) and developed by the Society for Research on Educational Effectiveness (SREE) in collaboration with the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan. It is maintained at ICPSR. REES is aimed at intervention studies in education and related fields. It includes studies conducted within and outside of the USA.

Registry Details

We examine three dimensions of the five registries: focus, study design, and contents of registry entries. Unsurprisingly, there is significant overlap across the registries because all five registries share the goal of increasing transparency.

Focus

The focus of each registry is reported in row 1 of Table 1. ClinicalTrials.gov focuses on studies seeking to assess the effect of interventions on biomedical or health outcomes. The OSF Preregistration is the most general of the five registries, with no particular substantive focus. REES and the AEA RCT both have specific foci—education and economics/political science, respectively; however, both also accommodate studies in other areas of the social sciences. RIDIE's content focus is broad, ranging from health and education to urban development, but unlike the other four registries, it is limited to intervention studies from low- and middle-income countries.

As the table shows, there is quite a bit of overlap in terms of focus across the registries. For example, although education intervention studies match the focus of REES, they could potentially fit with the AEA RCT Registry, OSF Preregistration, or RIDIE (if the study focused on a low- or middle-income country).

Study Designs

Row 2 of Table 1 describes the intervention study research designs that each registry accommodates.[1] Not surprisingly, all the registries invite researchers to register randomized controlled trials (RCTs). However, the AEA RCT Registry accommodates only RCTs and is thus the most specialized. The remaining four registries accommodate intervention studies using other designs, for example quasi-experimental designs (QEDs) in which participants are nonrandomly assigned to conditions.

Contents of Registry Entries

Each of the five registries uses a combination of questions or prompts with closed and open-ended responses to elicit information about a study. In addition, each registry allows additional materials to be uploaded to the registration. In order to examine and compare the specific content required or optionally captured in a prospective registration in these registries, we compiled lists of the questions and information prompts for each of the five registries. This list included 76 key prompts or questions.[2] Then, we aligned those questions and prompts capturing similar information across registries, taking account of differences in language used across disciplines. For example, some registries use the term "primary research questions" whereas others use "confirmatory research questions" to refer to essentially the same information. In these cases, we selected one term to describe the genre of information to facilitate

[1] ClinicalTrials.gov and OSF accept studies that are not intervention studies. However, the focus of our comparisons is only on the intervention studies across the registries.

[2] More details on the prompts and coding process are available at https://osf.io/gj2r6/

Table 1 Five prominent registries relevant to prevention science

ClinicalTrials.gov	AEA RCT	OSF Preregistration	RIDIE	REES
Focus				
Biomedical or health sciences including physical, psychological or behavioral health	Economics, political science, and other social sciences	Any topic area	Program evaluations (e.g. education, nutrition, health, urban development) in low- and middle-income countries	Education and other social sciences
Research designs				
Randomized controlled trials; quasi-experimental designs[a]; other designs	Randomized controlled trials	Randomized controlled trials; quasi-experimental designs; other designs	Randomized controlled trials; quasi-experimental designs; other designs	Randomized controlled trials; quasi-experimental designs; other designs
Developers/host				
National Library of Medicine	American Economic Association, Abdul Latif Jameel Poverty Action Lab	Open Science Foundation	International Initiative for Impact Evaluation, Rand Corporation	Society for Research on Educational Effectiveness & Inter-university Consortium for Political & Social Research
Registered studies[b]				
285,627[c]	4307	13,366[d]	208	208
Earliest registration date				
2000	2012	2013	2013	2018

[a]ClinicalTrials.gov calls these *non-randomized designs*

[b]The number of registered studies is as of February 2, 2020

[c]This number includes intervention studies only

[d]This number includes all studies in the OSF Preregistration portal. It is not possible to identify intervention studies only

comparisons of the content solicited for each of the five registries. The final list included 34 questions or prompts.

We then coded whether each registry directly asks researchers to respond to the content in the 34 questions or prompts. For example, each of the registries asks researchers to specify the research design (e.g. whether it is an RCT, QED, or other design). Hence, every registry received a check for that item. If questions or prompts were specifically denoted as optional, we noted this as "O."

The comparison of content for the 34 questions or prompts is very fine-grained. To summarize these comparisons in a meaningful way, we focused on two subsets of questions and prompts (a) those that provide basic study information and (b) those that provide more specific information about the study design, research questions/hypotheses or outcomes, and analysis plans. The basic information is important because it promotes awareness of the study and can help reduce selective reporting of entire studies. Details about the design, research questions/hypotheses or outcomes, and the analysis plans are important because they encourage full reporting of findings and enable detection of selective or incomplete reporting.

Basic study information common to all five registries includes data related to funders, principal investigators, start and end dates, intervention description, and keywords. Although the level of detail differs across the registries, in all cases, we judge that the registries collect an adequate level of important identifying information (Table 2).

The information related to design, research questions/hypotheses or outcomes, and analysis plans varied somewhat across the registries. All five registries ask the researcher to describe the study design. However, the registries vary in their language and the level of detail they request. For example, REES, which targets education intervention studies, asks researchers to specify whether the study is an RCT or uses another specific design. Based on the respondent's answer, it uses branching/skip logic to probe more deeply into the design. For example, if the study is described as an RCT, a set of questions then follow to determine if it is a single-level or cluster RCT, single or multisite RCT, and so forth. ClinicalTrials.gov asks the researcher to specify whether the allocation is randomized or nonrandomized, as well as whether the model is a single-group, parallel-group, crossover, factorial, or sequential design. Across all five registries, researchers are asked to specify some information about the sample size. However, as is the case for questions about study design, the level of detail requested on sample size varies across registries.

The next block of information relates to outcomes. Across the registries, the terms *research questions, hypotheses,* and *outcomes* are used in the context of seeking a clear delineation of the primary and secondary outcomes for studies. To simplify language, we use the terms *primary outcomes* and *secondary outcomes* hereafter. Selective or incomplete reporting of findings often occurs when authors fail to report

Table 2 Comparison of design and analysis prompts/questions across the five registries

	ClinicalTrials.gov	AEA RCT	OSF Preregistration	RIDIE	REES
Basic study information	√	√	√	√	√
Study design					
Specification of research designs	√	√	√	√	√
Sample sizes	√	√	√	√	√
Outcomes					
Primary outcomes	√	√	√	$\surd^{O}$	√
Secondary outcomes	√	O	O	$\surd^{O}$	O
Analysis plans					
Analytic models or plan	AP	AP	√	AP	√
Handling missing data	AP	AP	O	AP	√
Handling multiple comparisons	AP	AP	O	AP	√

Specific details for information in each registry can be found at ClinicalTrials.gov: https://prsinfo.clinicaltrials.gov/Interventional_Study_Protocol_Registration_Template_Jan_2018.pdf

AEA RCT Registry: https://www.socialscienceregistry.org/AEA_RCT_Registry_Data_Elements_Definitions.pdf

OSF Preregistration Portal: https://osf.io/jea94/

RIDIE: https://ridie.3ieimpact.org/index.php?r=site/page&view=faqsForResearchersGeneral, link in item 13.

REES: https://sreereg.icpsr.umich.edu/sreereg/checklist

O indicates there is a direct question or prompt but that it is specifically denoted as optional.

$\surd^{O}$ indicates that outcomes need to be specified but distinguishing between primary and secondary outcomes is optional

AP optional analysis plan

findings for all of the primary outcomes, when they report secondary outcomes rather than primary outcomes, or when they are simply unclear about their primary and secondary outcomes. As noted earlier, there is strong evidence in the literature of underreporting of nonsignificant and adverse findings and of selectively reporting positive and statistically significant findings for secondary outcomes (van der Steen et al., 2018).

ClinicalTrials.gov, the AEA RCT Registry, the OSF Preregistration, and REES all have prompts for reporting primary outcomes. This is critical because as long as primary outcomes are specified in a prospective registration, a secondary outcome cannot later be reported as a primary outcome. Prompts for secondary outcomes are also included in ClinicalTrials.gov and optional in the OSF Preregistration, the AEA RCT Registry, and REES. RIDIE also asks about outcomes. However, RIDIE notes that one "may distinguish primary and secondary outcomes[3]…" We strongly encourage distinguishing primary and secondary outcomes in RIDIE to ensure transparent and complete reporting of findings.

The final block of information we considered relates to the analysis plan. Although there are many components of analysis plans, we examined three: (a) the analytic model or a plan for analyzing the data, (b) the plan for handling missing data, and (c) the plan for handling multiple comparisons. We selected these components because the credibility of study findings may be especially sensitive to them and, thus, deviations from them may result in selective reporting. For example, if positive outcomes occur only after exploring many model combinations with various covariates, reporting only the positive findings would be misleading and may bias the evidence base.

OSF Preregistration and REES both have direct questions or prompts for information about the analysis plan. For example, REES asks the researcher to provide the *analytic model* whereas the OSF Preregistration uses the language *statistical model*. Both registries ask the researcher to delineate the plan for handling cases with missing outcome data and the plan for correcting for multiple comparisons, though these are considered optional in the OSF Preregistration. ClinicalTrials.gov, the AEA RCT Registry, and RIDIE do not directly ask for this information as part of their prospective registrations. However, researchers can submit this information as a separate attachment, often referred to as a statistical analysis plan (SAP) in ClinicalTrials.gov or a pre-analysis plan (PAP) in the AEA RCT Registry and RIDIE.

[3] Please see item 13 in the frequently asked questions document found at https://ridie.3ieimpact.org/index.php?r=site/page&view=faqsForResearchersGeneral. Then download the RIDIE Study Registration Fields Example.

Note that under Clinical Trials Registration and Results Information Submission (2016), a US federal regulation that took effect in January 2017, study authors must add their study results and protocols, which include analysis plans, to their study registrations within 1 year of study completion. In other words, submission of an analysis plan is required as part of the retrospective registration and is optional in the prospective registration.

Looking across Table 2, a key difference across registries is related to submission of analysis plans, which is optional in a prospective registration in ClinicalTrials.gov, the AEA RCT Registry, and RIDIE. This may reflect different perspectives on prospective registration. Some argue that analysis plans are not necessary for minimizing selective or incomplete reporting of findings and that specification of primary outcomes is sufficient (Banerjee et al., 2020). That is, specifying the primary outcomes allows one to check whether all primary outcomes in the original plan are reported. Further, specifying planned statistical analyses can be viewed as too cumbersome or restrictive (Banerjee et al., 2020). However, others argue that prospectively registering the planned statistical analyses is critical in assessing the alignment between the original and implemented analysis plans and for ensuring clear delineation between primary and secondary analyses (Nosek et al., 2018). As the field of prevention science moves forward, establishing norms around whether or not planned statistical analyses should be included in a prospective registration will be important. However, it is not a limiting factor since all five registries allow this information to be uploaded.

Paths Forward for Study Registration for Prevention Science Research

Our examination of the five registries revealed many similarities with respect to the information collected across the registries, particularly if researchers provide the optional information. Hence, a logical question is where to register a prevention science study. We consider two promising paths forward for promoting systematic registration of intervention studies in the field of prevention science. Path A identifies a single registry for intervention studies in prevention science. Under this scenario, the most logical choice would be ClinicalTrials.gov given its long-standing reputation in the field and relevance for many intervention trials in prevention science. Path B encourages prevention science researchers to use the registry they deem to be the "best fit". We consider each path below.

Path A follows a "one size fits all" model; all prevention scientists register their intervention studies in ClinicalTrials.gov. ClinicalTrials.gov is the largest registry of intervention studies and has the longest history. It also is a natural fit for

the many health-related intervention studies in prevention science. ClinicalTrials.gov is general enough that, arguably, it could capture the critical registration information for almost any intervention study. For example, many studies in prevention science consider long-term outcomes, including ones that may be identified only as preliminary findings emerge from the study. ClinicalTrials.gov allows researchers to specify time points for planned data collection and to update design details over time. The result of Path A would be one central registry housing all intervention studies in prevention science.

Path B follows a "best fit" model as judged by the prevention scientists, who may differ in the criteria they use for judging "fit." Some researchers may prioritize the alignment of the registry with the substantive focus of their study, reasoning that this will improve the likelihood that the registration will be accessed by researchers and other stakeholders working on that focal set of concerns. Others might prioritize familiarity with the registry and/or its ease of use for completing and managing study registrations.

Path B may, but need not, include decisions by researchers to register in multiple registries. For example, imagine a study to test a behavior intervention for elementary students in Algeria. Since the study was conducted in a low- or middle-income country, it would be relevant for RIDIE. However, since the study takes place in the school setting, it would also be a good fit in REES. Including the study in both registries would give it more exposure to interested researchers and policymakers. However, registering in multiple registries may also be considered an inefficient use of resources as it takes time to enter the study in both places. Further, it may lead to double counting of a study if it is not clear through the study ID that the same study is registered in more than one place.

A downside of Path A is that registration information for prevention science research may not be as widely accessed and used by researchers and practitioners seeking guidance on studies assessing the impact of interventions outside of the physical, psychological, or behavioral health such as those aimed to improve educational contexts or economic circumstances. This is because the researchers and practitioners may not think to check ClinicalTrials.gov as it is less focused on studies in the social sciences. A downside of Path B is that prevention scientists who work across content areas may end up using multiple registries due to the varied content and study design features of particular registries.

As the field considers the optimal path for promoting registration of prevention science research, several additional factors are worth considering. The first factor is funder requirements. For example, the National Institutes of Health (NIH) requires that all clinical trials funded by NIH be registered in ClinicalTrials.gov (NIH, n.d.-d). This requirement fits nicely with Path A, or universal registration of prevention science research in ClinicalTrials.gov. In contrast, the Institute of Education Sciences (IES) strongly encourages researchers to register their intervention studies, frequently called *impact studies* by IES, following the Standards for Excellence in Education Research.[4] These standards include (a) pre-register research and analysis activities in a *recognized study registry*; (b) describe key elements of the study protocol in their registration, including plans for analyzing a limited number of primary outcomes; and (c) identify and justify policy-relevant effect sizes for the primary outcomes in their registration, and design the study to credibly detect such effects. Examples of "recognized registries" identified by IES include but are not limited to REES, OSF, ClinicalTrials.gov, and the AEA RCT Registry. Thus, researchers have flexibility in their choice of the registry they use for IES-funded studies—a policy aligning with Path B.

A second factor for consideration is journal requirements. Some journals require prospective registration for publication and, in some cases, they even specify where the study must be registered.[5] For example, many medical journals require registration in a registry included in the World Health Organization International Clinical Trials Registry Platform (WHO ICTRP), of which ClinicalTrials.gov is the only one of this set of five registries included, hence aligning with Path A. Other journals require or encourage prospective registration but do not specify a particular registry. Notably, *Prevention Science* encourages prospective registration but does not specify a particular registry, which aligns with Path B. As the field moves forward, journal policies related to whether and where studies are prospectively registered will be critical to shaping the field.

Moving Toward Registration as a Norm in Prevention Science

Although prospective registration is becoming more common, it is certainly not standard practice in many fields, including prevention science. Hence, a key question is: What will it take for registration to become a norm in the field of prevention science? This question is not unique to the field of prevention science. Yet, some fields—most notably, medicine—are far ahead and offer some guidance. There is evidence from medicine that journal policies play a critical

[4] See IES Standards for Excellence in Education Research, Preregistration of studies; accessed September 1, 2020, at https://ies.ed.gov/seer/preregistration.asp.

[5] The Open Science Foundation maintains a list of journals with links to their editorial policies that may be a useful resource; accessed September 1, 2020, at https://docs.google.com/spreadsheets/d/1D4_k-8C_UENTRtbPzXfhjEyu3BfLxdOsn9j-otrO870/edit#gid=0.

role in making prospective registration a norm. Since 2005, all International Committee of Medical Journal Editors (ICMJE) member journals and hundreds of other journals have required prospective registration of trials in order to be considered for publication (DeAngelis et al., 2004). Note that member journals include the top medical journals such as *Journal of the American Medical Association* (JAMA) and the *New England Journal of Medicine.* This policy led to a dramatic increase in the frequency of prospective registration (Zarin et al., 2011, 2017).

The lesson for the field of prevention science is clear. Journal policies requiring, rather than simply encouraging, prospective registration will lead to increased frequency of prospective registration. As noted earlier, the flagship journal for the field, *Prevention Science*, currently encourages prospective registration but does not require it. Further, it does not specify a particular registry. Requiring prospective registration in the future, whether following Path A and specifying one registry, ClinicalTrials.gov, or Path B, researchers' choice of registry, represents a clear step toward establishing prospective registration as a norm for the field.

Although not as strong as requiring prospective registration, journal policies that encourage or incentivize registration can also impact the field. For example, awarding transparency badges to studies that were prospectively registered may increase the likelihood of researchers registering studies.

In addition to journal policies, researchers themselves play a critical role in prospective registration becoming a norm in prevention science. Embracing transparency and encouraging other researchers to do the same will help shift the culture. Further, training graduate students in why and how to prospectively register studies is important. Beyond registration, training graduate students in other open science practices is critical. For example, the Center for Open Science supports the Open Science Framework, which provides resources for improving transparency at all stages of research from prospective registration to sharing data and reporting findings. Training the next generation of researchers in open science practices will help them embrace these practices and infuse them into daily work.

Establishing new norms for a field is not easy. It requires sharing new ideas and healthy dialogues. Consensus building around the best path for moving forward and buy-in from key stakeholders (e.g., researchers, journal editors, professional associations) are critical in making prospective registration a norm in the field of prevention science.

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References

Banerjee, A., Duflo, E., Finkelstein, A., Katz, L., Olken, B., & Sautmann, A. (2020). *In praise of moderation: Suggestions for the scope and use of pre-analysis plan for RCTs in economics* (Working paper 26993). National Bureau of Economic Research. https://www.nber.org/papers/w26993

Banks, G. C., & McDaniel, M. A. (2011). The kryptonite of evidence-based I-O psychology. *Industrial and Organizational Psychology, 4*, 40–44. https://doi.org/10.1111/j.1754-9434.2010.01292.x

Brodeur, A., Cook, N., & Heyes, A. (2018). *Methods matter: P-Hacking and causal inference in economics* (IZA Discussion Papers, No. 11796). Institute of Labor Economics. https://www.econstor.eu/bitstream/10419/185256/1/dp11796.pdf

Chamber, C. D. (2013). Registered reports: A new publishing initiative at Cortex. *Cortex, 49*, 609–610. https://doi.org/10.1016/j.cortex.2012.12.016

Clinical Trials Registration and Results Information Submission. 42 C.F.R. § 11. (2016). https://ecfr.federalregister.gov/current/title-42/chapter-I/subchapter-A/part-11

DeAngelis, C., Drazen, J. M., Frizelle, F. A., Huag, C., Hoey, J., Horton, R., Kotzin, S., Laine, C., Marusic, A., Overbeke, J. P. M., Schroeder, T. V., & Sox, H. C. (2004). Clinical trials registration: A statement from the International Committee of Medical Journal Editors. *The New England Journal of Medicine, 351*, 1250–1251. https://doi.org/10.1056/nejme048225

Dwan, K., Gamble, C., Williamson, P. R., & Kirkham, J. J. (2013). Systematic review of the empirical evidence of study publication bias and outcome reporting bias—An updated review. *PLOS One, 8*, e66844. https://doi.org/10.1371/journal.pone.0066844

Franco, A., Malhotra, N., & Simonovits, G. (2014). Publication bias in the social sciences: Unlocking the file drawer. *Science, 345*, 1502–1505. https://doi.org/10.1126/science.1255484

Gelman, A., & Loken, E. (2013). *The garden of forking paths: Why multiple comparisons can be a problem, even when there is no "fishing expedition" or "p-hacking" and the research hypothesis was posited ahead of time.* Department of Statistics at Columbia University. http://www.stat.columbia.edu/~gelman/research/unpublished/p_hacking.pdf

Goodman, S. N., Fanelli, D., & Ioannidis, J. P. A. (2016). What does reproducibility mean? *Science Translational Medicine, 8*, 341–353. https://doi.org/10.1126/scitranslmed.aaf5027

Kerr, N. L. (1998). HARKing: Hypothesizing after the results are known. *Personality and Social Psychology Review, 2*, 196–217. https://doi.org/10.1207/s15327957pspr0203_4

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. SAGE Publications, Inc.

Mahoney, M. J. (1977). Publication prejudices: An experimental study of confirmatory bias in the peer review system. *Cognitive Therapy and Research, 1*, 161–175. https://doi.org/10.1007/BF01173636

NIH. (n.d.-a). Prevention research defined. Retrieved from https://prevention.nih.gov/about-odp/prevention-research-defined. Accessed 31 August 2020.

NIH. (n.d.-b). ClinicalTrials.gov background. Retrieved from https://clinicaltrials.gov/ct2/about-site/background

NIH. (n.d.-c). History, policies, laws. Retrieved from https://clinicaltrials.gov/ct2/about-site/history#CongressPassesLawFDAMA

NIH. (n.d.-d). NIH Policy on the Dissemination of NIH-Funded Clinical Trial Information. Retrieved from https://grants.nih.gov/grants/guide/notice-files/NOT-OD-16-149.html

Norris, S. L., Moher, D., Reeves, B. C., Shea, B., Loke, Y., Garner, S., Anderson, L., Tugwell, P., & Wells, G. (2013). Issues relating to selective reporting when including non-randomized studies in systematic review on the effects of healthcare interventions. *Research Synthesis Methods, 4*, 36–47. https://doi.org/10.1002/jrsm.1062

Nosek, B. A., Ebersole, C. R., DeHaven, A. C., & Mellor, D. T. (2018). Preregistration revolution. *Proceedings of the National Academy of Sciences, 115*, 2600–2606. https://doi.org/10.1073/pnas.1708274114

Pigott, T. D., Valentine, J. C., Polanin, J. R., Williams, R. T., & Canada, D. D. (2013). Outcome-reporting bias in education research. *Educational Researcher, 42*, 424–432. https://doi.org/10.3102/0013189X13507104

Pigott, T. D., Williams, R. T., & Valentine, J. C. (2017). *Selective outcome reporting and research quality.* In M. C. Makel & J. A. Plucker (Eds.), *Toward a more perfect psychology: Improving trust, accuracy, and transparency in research* (pp. 79–96). American Psychological Association. https://doi.org/10.1037/0000033-005

Reich, J., Gehlbach, H., & Albers, C. J. (2020). "Like upgrading from a typewriter to a computer": Registered reports in education research. *AERA Open, 6*, 1–6. https://doi.org/10.1177/2332858420917640

Rice, D. B., & Moher, D. (2019). Curtailing the use of preregistration: A misused term. *Perspectives on Psychological Science, 14*, 1105–1108. https://doi.org/10.1177/1745691619858427

Robbins, H. E. (1968). Estimating the total probability of the unobserved outcomes of an experiment. *The Annals of Mathematical Statistics*, *39*, 256–257. http://www.jstor.org/stable/2238931

Rubin, M. (2017). When does HARKing hurt? Identifying when different types of undisclosed post hoc hypothesizing harm scientific progress. *Review of General Psychology, 21*, 308–320. https://doi.org/10.1037/gpr0000128

Sutton, A. J., & Pigott, T. D. (2005). Bias in meta-analysis induced by incompletely reported studies. In H. R. Rothstein, A. J. Sutton, & M. Borenstein (Eds.), *Publication bias in meta-analysis* (pp. 223–239). John Wiley & Sons.

van der Steen, J. T., van den Bogert, C. A., van Soest-Poortvliet, M. C., Fazeli Farsani, S., Otten, R. H., Ter Riet, G., & Bouter, L. M. (2018). Determinants of selective reporting: A taxonomy based on content analysis of a random selection of the literature. *PLOS One, 13*, e0188247. https://doi.org/10.1371/journal.pone.0188247

Zarin, D. A., Tse, T., Williams, R. J., Califf, R. M., & Ide, N. C. (2011). The ClinicalTrials.gov results database – Update and key issues. *The New England Journal of Medicine, 364*, 852–860. https://www.nejm.org/doi/full/10.1056/NEJMsa1012065

Zarin, D. A., Tse, T., Williams, R. J., & Rajakannan, T. (2017). Update on trial registration 11 years after the ICMJE policy was established. *The New England Journal of Medicine, 376,* 383–391. https://www.nejm.org/doi/full/10.1056/nejmsr1601330