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Using a Logic Model to Document HIV Research Utilization (RU) Activities, Outputs and Outcomes: Examples and Lessons Learned from Project SOAR, a Six-year Implementation Science Project.

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Abstract:	Summary Points While there is general agreement that researchers should make effort to ensure that their research gets used to improve policies and practices, there is limited literature on measuring outcomes of research utilization efforts. We propose that research utilization activities and outcomes can be measured using a logic model for assessing program inputs, outputs, outcomes and ultimate impact. We use experiences from Project SOAR, a six-year implementation science project, to illustrate how RU activities and outcomes can be measured using a logic model. We highlight common challenges in measuring RU outcomes including reporting bias, how to attribute program change to specific research findings, and the unpredictable time lag between research publication and use. We make recommendations for addressing these challenges.
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Dear Editorial Team,

This essay is submitted as part of the Project SOAR Special Collection - FAO: PLOS Collections collections@plos.org'. It is titled: *Using a Logic Model to Document HIV Research Utilization (RU) Activities, Outputs and Outcomes: Examples and Lessons Learned from Project SOAR, a Six-year Implementation Science Project.* This essay aims to contribute to science by highlighting the importance of integrating systematic research utilization activities in a research project to facilitate stakeholders to use research findings in improving policies and practices. However, there is a limited knowledge base on how to monitor and evaluate activities conducted in the name of research utilization. To contribute to this knowledge base, we use experiences from Project SOAR, a six-year implementation science project, to illustrate that research utilization activities and outcomes can be measured using a logic model. We also highlight common challenges in measuring RU outcomes including reporting bias, how to attribute program change to specific research findings, and the unpredictable time lag between research publication and use. We make recommendations for addressing these challenges.

Our submission package includes this letter, the manuscript on PLOS ONE template and Fig 1 in a .tif file. We trust that this package meets the submission requirements of PLOS ONE.

We thank you for your good work.

Yours sincerely.

Samuel Kalibala MD.

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Short title: **Logic Model for HIV Research Utilization (RU) Activities, Outputs and Outcomes**

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Summary Points

- While there is general agreement that researchers should make effort to ensure that their research gets used to improve policies and practices, there is limited literature on measuring outcomes of research utilization efforts.
- We propose that research utilization activities and outcomes can be measured using a logic model for assessing program inputs, outputs, outcomes and ultimate impact.
- We use experiences from Project SOAR, a six-year implementation science project, to illustrate how RU activities and outcomes can be measured using a logic model.
- We highlight common challenges in measuring RU outcomes including reporting bias, how to attribute program change to specific research findings, and the unpredictable time lag between research publication and use. We make recommendations for addressing these challenges.

Introduction

While substantial literature exists documenting the inputs and outputs of implementing RU activities, there is limited literature on measuring the outcomes of RU activities [1]. Validated tools for measuring research use are scarce; in a literature review of measuring research utilization Estabrooks and Wallin [2] noted that researchers who have measured research use have tended to develop their own tools. Straus et al [3], report another literature review which concludes that the most common methods rely on self-report by investigators or stakeholders.

This essay aims to contribute to the limited but growing body of knowledge on how to measure outcomes of RU, by discussing lessons learned in documenting RU inputs, outputs and outcomes in Project SOAR including some key challenges and recommendations for addressing them. Project SOAR

(Supporting Operational AIDS Research) is a six-year implementation science (IS) project, funded by the United States Agency for International Aid (USAID), that was designed to improve HIV service delivery by conducting high quality research to meet data needs of stakeholders, strengthen the capacity of stakeholders to conduct IS research and use study findings to guide planning, funding and implementation of programs.

Research utilization (RU) can be defined as "the implementation of research-based knowledge (science) in practice" [2]. Defining RU as a form of implementation or program activity implies that it should be subject to a logic model of evaluation. The Centers for Disease Control and Prevention (CDC) has outlined the following components of a logic model for evaluating sexually transmitted infections (STI) programs [4]:

a) Inputs (resources): funding, staff, materials;
b) Activities (program, events or strategies): staff training, patient testing and treatment
c) Outputs (products of activities): number of patients treated, quality of training
d) Short-term outcomes (immediate effects, weeks-months): changes in knowledge, skills, or beliefs, increased proportion of patients treated
e) Intermediate outcomes (intended effects that occur over the mid-term: months-years): changes in policies or behaviors, increased proportion of partners treated, increased condom use
f) Long term outcomes (long term intended effects: years or decades): reduced STD prevalence; changes in morbidity or mortality

Logic model for Project SOAR's RU activities

CDC's logic model was designed for monitoring and evaluating STI programs however, these components are widely accepted as the key elements of logic models. In this essay we focus on RU as the program and demonstrate, using examples from Project SOAR, how RU inputs, activities, outputs and outcomes are measured. To accomplish this, we have slightly modified CDC's logic model as shown in Fig 1. SOAR's inputs into research utilization are comprised of staff time, funding for travel, meetings and workshops; and a guidance document and tools to facilitate activity implementation. Outputs of these activities were the number of meetings and dissemination events conducted by study teams to engage stakeholders in study implementation and results dissemination. The outcomes are defined as the use of study findings, by stakeholders, to improve services, guidelines and policies with the ultimate long-term impact being the improvement in the UNAIDS 90-90-90 goals. The UNAIDS "90-90-90" strategy calls for 90% of HIV-infected individuals to be diagnosed by 2020, 90% of whom will be on anti-retroviral therapy (ART) and 90% of whom will achieve sustained virologic suppression.

Fig 1 here.

Project SOAR's stakeholder engagement template

To document RU inputs, activities, outputs and outcomes Project SOAR developed and applied the Stakeholder Engagement Template shown in Table 1 that was completed and submitted by Principal Investigators (PIs) of each study as part of the six-monthly study progress reports to Project SOAR management. The template includes the names of stakeholders they engaged, the dates and modes of engagement, as well as what was discussed during the engagements. The engagement with stakeholders started in the inception phase of each study, during which the study design and methodology were discussed and continued into later phases of the study. During later phases of the study researchers shared preliminary and eventually final study data with stakeholders. Researchers also engaged stakeholders

through existing Technical Working Groups (TWGs) or study-specific research advisory committees (RACs) using presentations and results briefs to present study results. Each SOAR study conducted one RAC meeting at inception, another to share preliminary study results, followed by a data interpretation meeting to discuss the final study findings and determine study recommendations before conducting a final study dissemination meeting attended by a group of stakeholders beyond the TWG or RAC. In each case the researchers reported to SOAR management the key aspects of the meeting using the template in Table 1. To generate the short-term and intermediate RU outcomes discussed, later in Tables 5 and 6, we extracted data from the last column of the template "outcomes of the meeting/reactions of stakeholders."

Table-1: Stakeholder engagement template

Example from Lesotho IMPROVE study [5]

Stakeholder(s)	**Date of engagement**	**Mode of engagement**	**What was discussed, presented (e.g., study design, baseline findings)**	**Outcome(s) of the meeting / reaction of stakeholder(s)**
PMTCT technical working group (TWG) Committee – Ministry of Health (MOH)	16 Oct 2018	Face-to-face meeting at MOH	Study team provided study progress update and key early lessons.	-The head of the Family Health division at MOH expressed a great interest in the different aspects of community-based support. She communicated her plan to use the lessons learned to revive the National village health workers (VHW) program. -The TWG expressed interest in adopting key aspects of the intervention to include in the routine Maternal and Neonatal Child Health (MNCH) services at the end of the study.
Facility leadership including staff	November to Dec 2018	Face-to-face onsite meetings at respective facilities.	Facility-specific update on study implementation progress	Each facility decided on strategies to address gaps identified by the study in the areas of retention and follow up challenges.

Using a prospective tool of this nature, completed as the research progresses, enables researchers to capture interactions with stakeholders about how they intend to use research results. These "indicators as they emerge" [6] are more helpful to tracking and understanding research use compared to an

assessment conducted after the study is completed, that could suffer from recall bias [7]. To facilitate the formation of RACs and the conduct of meetings as well as data dissemination activities, Project SOAR invested several inputs as discussed below.

Documenting RU inputs and outputs

Inputs: staff, activities budget, resource materials

SOAR embedded RU activities in all research studies using defined *RU Guidance* and tools, and a dedicated knowledge broker—the Senior Research Utilization Advisor—to promote RU among SOAR researchers, provide technical assistance and monitor how SOAR research had been utilized for program and policy changes. Thus, RU inputs included implementation of the guidance document and tools as well as staff time of the RU Advisor who provided technical input in study protocols to ensure study outcomes were aligned to salient issues in programs and policies of the country where research was being conducted. To start with the RU advisor worked with PIs to conduct study protocol development trips to study countries during which they scoped the landscape of stakeholders and policy issues relevant to the research topic of interest as well as possible research collaborators including a potential in-country co-Principal Investigator (co-PI) for each study. The RU advisor then worked with researchers to establish forums for continuous engagement of stakeholders either through existing technical working groups (TWGs) or by forming study-specific research advisory committees (RAC). Further, the RU advisor worked with researchers to strengthen the capacity of in-country investigators and governmental

stakeholders to access, review and use research to improve programs/policies through workshops and small grants. In addition, the RU advisor and SOAR's Science Writer and Knowledge Management Specialist worked with researchers to analyze the data, identify key findings, develop practical recommendations and develop power point presentations, activity briefs and results briefs that researchers used to present their research and results to stakeholders. Further details of the process of engagement of stakeholders in SOAR studies are provided in a previous publication [8].

Table 2 shows the inputs that included a full time Senior Research Utilization Advisor and Science Writer together with a 50% Knowledge Management Specialist. In addition to the staff positions, Project SOAR also developed the RU guidance document and tools and, had dedicated funds that supported staff travel, meetings, workshops and small grants discussed later.

Table-2: Input: staff, resource materials

Resource	**Remark**
Senior Research Utilization Advisor	One Full Time Employee
Science Writer	One Full Time Employee
Knowledge Management Specialist	One 50% Employee
Research utilization process guidance document and tools produced and disseminated throughout the consortium [9]	One document

Activities: staff training, small grants initiative and technical support

To facilitate RU, Project SOAR conducted activities to strengthen the capacity of stakeholders to generate, analyze and use research findings. During site selection exploratory visits to study countries, Project SOAR PIs identified in-country colleagues to act as co-PIs on the studies as well as key stakeholders to help refine research questions, so they addressed priority policy and program needs in the country. As shown in Table 3, Project SOAR convened and conducted two regional capacity strengthening workshops in Johannesburg South Africa February 2017 and May 2018 attended by 48 in-country co-PIs and key stakeholders focusing on skills building for research generation and use. To enable in-country study teams to apply the skills they learned to generate and use data, Project SOAR sent out a request for proposals to in-country study teams and issued small grants of not more than $10,000 each for nine out of the 16 applications received. Using these funds, in-country researchers conducted secondary analyses to address locally relevant research questions, convened stakeholder meetings to disseminated findings and submitted conference abstracts and journal manuscripts. The RU advisor also provided technical support to study teams by way of country visits, phone calls and e-mails. He supported the formation of country-level research advisory committees (RAC). By the end of year 5, Project SOAR had established 54 RACs and facilitated the RACs to develop 46 in-country data use plans. Members of Project SOAR's scientific team supported in-country teams by reviewing their draft publications and by mentoring small grant recipients. The RU Advisor, the science writer and the knowledge management specialist also supported the researchers in editing, formatting and preparing publications ensuring that the publications highlighted programmatic and policy implications of study findings.

Table-3: Activities to facilitate RU: staff training, small grants initiative and technical support visits

Activity Type	Achieved by end of Yr-5	Remarks

RU Capacity Strengthening Workshops for in-country researchers and stakeholders	2 four-day regional workshops in Johannesburg, South Africa	-Feb 2017: 28 participants, from 12 countries -May 2018: 20 participants from 8 countries.
Small Grants proposals submitted by in-country researchers	16 applications received, 9 selected.	About $10,000 per grant
Technical Support Visits by RU Advisor	45	
Formation of Research Advisory Committees (RACs)	54 (Out of 58 studies initiated)	A few nested studies shared the research advisory committee of the parent study.

Outputs: # RU meetings, #disseminations and #publications

As shown above Project SOAR conducted technical support and capacity strengthening activities directed at in-country research teams and stakeholders to enable them to carry out RU activities. Table-4 shows the RU outputs generated by study teams and stakeholders as a result of Project SOAR's inputs. The RACs developed a data use plan that they used to engage stakeholders throughout the study as a living document that they modified as they gained more knowledge about the landscape of stakeholders and priority program and policy issues; the final data use plan, developed at the final dissemination meeting, was a plan for continued engagement of stakeholders after the close of Project SOAR. As part of the ongoing data use plan, RACs identified and coached champions to continue engaging stakeholders in various forums to integrate study findings into decision making processes.

As shown in Table 4, SOAR researchers developed 58 Activity Briefs and 74 Results Briefs. These are brief documents used to disseminate study information to stakeholders; an Activity Brief is a 2-page document about each study stating the study's objectives, methods, and proposed RU process while a Results Brief focusses on key findings, programmatic implications, and recommendations. The briefs

were printed and shared with stakeholders as hardcopies and were also published on Project SOAR website. When discussing individual studies in the section on RU outcomes we name Project SOAR's studies using brief names and provide a reference to the study's activity or results brief on Project SOAR's website.

Table-4: Outputs: # RU meetings, #disseminations and #publications

Activity Type	**Achieved by end of Yr-5**	**Remarks**
Study-specific data use plans to guide dissemination of results locally	46 (Out of 58 studies)	Some studies were exempt from a in-country data use plan because they were global in nature.
Activity Briefs	58	One for each study
Results Briefs	74	Some studies had more than one results brief
Joint national research advisory group meetings in countries with multiple SOAR studies	11 One-day in-country meetings of about 40 participants each	-Three in Malawi: July 2017, Sept 2018, Nov 2019 -Three in South Africa: May 2017, Sept 2018, Nov 2019 -Two in Tanzania: Mar 2017, Nov 2019 -One in Uganda: Feb 2019 - One in Kenya: Feb 2019 - One in Zambia: Feb 2019
Briefings of national directors of AIDS programs and AIDS commissions	6 boardroom meetings at national AIDS program/council offices lasting about two hours each.	-Uganda: Aug 2018 - South Africa: Nov 2019 -Malawi: Oct 2018 - Kenya: Feb 2019 -Tanzania: May 2018 -Zambia: Feb 2017
Meetings (including webinars and informal briefings) convened with USAID and/or other stakeholders to share interim results from SOAR studies	116	

Oral/poster presentations given by SOAR PIs at international, regional, and national conferences	111	
Manuscripts submitted to peer reviewed journals	59	
Presentations sharing Best Practices from SOAR's RU approach	Four RU Technical Expert meetings	-Makerere University Medical School, Uganda: August 2018, 60 faculty members and researchers -Washington, DC Technical Advisory Network: May 2019, 50 RU experts -Mexico City, International AIDS Society (IAS) Conference: July 2019, Satellite meeting on RU - Kigali, Rwanda, International Conference on AIDS and STIs in Africa (ICASA): Dec 2019 Satellite meeting on RU
Publications sharing Best Practices from SOAR's RU approach	Four	-Blog on Capacity Strengthening on USAID website -Q&A on Project SOAR website -Two Journal articles in AIDS and Behavior

In the six countries where we had multiple studies, SOAR researchers conducted 11 joint research advisory group meetings that brought together an average of 40 study staff and key stakeholders in each country to interpret preliminary and final study findings, identify key findings and make practical actionable recommendations that applied study findings to strengthen policies and programs. In some of the countries where it was not possible for national authorities to attend dissemination meetings, SOAR researchers requested boardroom meetings at national AIDS program offices where they shared study findings with top-level government officials and discussed policy and programmatic implications of the findings.

Beyond national meetings, SOAR researchers shared interim research findings in 116 webinars and meetings convened by USAID and other stakeholders, in 111 oral and poster presentations in regional and international AIDS conferences and submitted 59 manuscripts to peer reviewed journals to further disseminate study findings. Apart from disseminating study findings, Project SOAR compiled and shared best practices of our RU approach to communities of practice through four technical expert meetings targeted to academia in Uganda, global-level RU experts convened in Washington, DC, satellite meetings at international HIV conferences in Mexico City and Kigali, a blog on capacity strengthening on the USAID website [10], a Q&A on Project SOAR website [11], and two journal articles in AIDS and Behavior [8, 12].

While sharing knowledge of study findings with key stakeholders may not be effective on its own to change practices or policies, it is a necessary pre-requisite to change [1]. In analyzing the utilization of study findings, it is important to know whether the knowledge was shared with relevant stakeholders aka "target policy actors" [1]) or "receptor bodies that would potentially use the findings" [14]. And whether results were shared at the most opportune time [13], in an accessible format, and whether stakeholders engaged in the process. The outcome of stakeholder engagement is the use of study findings to improve policies and programs, and as explained in the next section, can vary from a change in the thinking about a problem, to a commitment to act, to tangible action for change.

Measuring outcomes of RU activities

The outcome of the above RU activities is research use. Several publications [15, 2, 3] propose at least three main domains of research use, where 'use' refers to an event or action by stakeholders to change programs/policies as a result of research. *Instrumental Use* is when stakeholders use research to

make policy/program decisions. *Conceptual Use* is when stakeholders apply the knowledge in their thinking and conceptual understanding of the issue [15] and use study findings in debates and "public and professional discourses" [13] without necessarily taking action to change policy or practice as a result of the study findings. And *Persuasive Use* is when stakeholders use research data to influence or persuade other stakeholders, such as politicians to pass a bill or community members to change a behavior.

When SOAR researchers shared research information, updates on the research process, or study findings, some stakeholders made comments and asked questions to seek clarification, interpret the data and draw programmatic/policy implications. These "productive interactions or instances of knowledge exchange" are often viewed as crucial *Conceptual Use* that leads to *Instrumental Use* (6) and should be documented [1]. Indeed, Penfield T et al [6] recommend documentation of the bi-directional flow of knowledge between researchers and stakeholders. Below we discuss examples of conceptual and persuasive use as short term outcomes; and instrumental use as intermediate outcomes.

Short term RU outcomes (weeks-months): commitments, policy debate

In the bi-directional exchange between researchers and stakeholders some stakeholders may make commitments to implement study recommendations. These commitments can thus be classified as *Conceptual Use*. Even though these commitments may be only verbal, it is important that study teams record these commitments in the report of the dissemination meeting as a prompt for future follow-up. Indeed, SOAR champions, identified in the data use plans (see Table 4) planned to follow-up to verify whether the stakeholders fulfilled these commitments, or if there were barriers hindering the fulfilment, how they could be addressed.

As shown in Table-5a several stakeholders stated a commitment to use the study intervention in some way such as integration into routine service delivery (Zambia Project YES, Tanzania GBV); and pilot-testing or taking the recommendation to scale (Namibia TnS, Uganda DISCO, Zambia Project YES). Other stakeholders committed to addressing service gaps identified by the study for example through improved program monitoring and evaluation (M&E) or training (Kenya and Uganda Pediatric Case Finding, Tanzania FSW/FP). It is notable that in some situations, although, at the time of reporting, no policy or program change was effected, a step in the right direction was taken. In Zambia Project YES, the integration of anti-stigma activities in the study intervention was a step towards developing an anti-stigma program; in the Kenya and Uganda Pediatric Case Finding, the development of quality improvement plans was a step towards improved programing.

Table-5a: Short-term outcomes (weeks- months): commitments, policy debate

Name of study	Key Finding	RU Outcome
Kenya and Uganda Pediatric Case Finding [16]	Formative data showed missed opportunities for prevention of mother to child transmission (PMTCT)	Program implementers developed quality improvement plans to address gaps
Zambia Project YES [17]	Formative study showed high levels of stigma	Investigators integrated anti-stigma components in the study intervention
Uganda PEPFAR Geographical Pivot [18]	Data showed that withdrawal of PEPFAR support from some health facilities in Uganda was not followed immediately by Uganda government support as expected	Policymakers reacted by debating the country's preparedness for the possible reduction in donor funding for ART.
Zambia Project YES [17]	Feasibility of transition intervention for youth on ART	A separate NGO expressed desire to adapt and use the study's intervention in their program.
Tanzania GBV [19]	Feasibility of gender-based violence (GBV) intervention in study facilities	MOH expressed desire to integrate intervention into routine health care

Namibia TnS [20]	The test and start program was feasible but there was lack of patient understanding of viral loads	MOH committed to develop and pilot-test Viral Load literacy intervention for patients on ART
Tanzania FSW/FP [21]	A proportion of women on ART expressed a desire for safer conception	MOH and implementing partner committed to strengthening the skills of staff in counseling on safer conception
Uganda DISCO [22]	Disclosure intervention, tested in the study, was highly efficacious among youths	Policymakers expressed interest in rolling out the intervention to a national scale

Other than commitments, another *Conceptual Use* of research can be an improvement in knowledge about a topic that feeds into policy debate. For example, the Uganda PEPFAR Geographical Pivot study showed that when PEPFAR transitioned out of some health facilities, the government was not immediately able to provide continuation of ART services. This finding elicited a debate among senior policymakers about the government's preparedness for donor withdrawal.

Table-5b shows examples of *Persuasive Use:* in the case of Malawi DREAMS, the epidemiologist intended to use study findings to influence the ongoing go/no-go discussions about PrEP use in this population; and the organizations retrieving data from the Global Fund repository on key populations intended to use the data to influence global policy and interventions.

Table-5b: Short-term outcomes (weeks- months): policy influence

Name of study	**Key Finding**	**RU Outcome**
Global Fund TA [23]	Study analyzed and deposited, in a data repository, HIV prevalence and incidence data for key populations	Global Fund, UNAIDS and CDC made data retrievals from the repository for use in policymaking
Malawi DREAMS [24]	Study showed high prevalence of herpes simplex among adolescent girls and young women (AGYW)	MOH epidemiologist confirmed that the data were vital for informing the ongoing go/no-go national discussions about the use of PrEP among AGYW

Intermediate outcomes (months-years): changes in policies or programs

Beyond statements of commitment, some stakeholders made policy/program decisions and acted on these decisions as a result of Project SOAR studies—*Instrumental Use*. As shown in Table 6, in Tanzania after learning that community-based ART improved initiation and retention among key populations, the MOH authorized community-based ART for those populations. All service delivery providers were informed of this change via a formal government circular. In Senegal, the AIDS program added HIV self-testing (HST) to the national strategy following a SOAR feasibility study. In Eswatini, on learning that a large proportion of children were using sub-optimal ARV regimens, the MOH changed their treatment policy to transition to more efficacious regimens. In Uganda and Eswatini the MOH used SOAR modelling results to modify the choice of priority populations to be targeted for PrEP nationally. In Zambia, USAID funded two implementing partners to address program gaps identified by a SOAR study by facilitating issuance of birth certificates and increasing HIV testing for OVC.

Table-6: Intermediate outcomes (months-years): changes in policies or programs

Name of study	Key Finding	RU Outcome
Tanzania FSW-ART [25]	Community-based ART distribution can lead to higher ART initiation rates with continued ART use and better adherence after six months	MOH changed national policy and issued a circular authorizing community-based ART initiation to Key and Vulnerable Populations
Senegal TnS [26]	Study showed feasibility of HIV self-testing (HST) (Senegal TnS),	National AIDS program included HST in the national HIV test and start strategy
Eswatini FAMCARE [27]	43.1% of children were receiving a suboptimal Nevirapine (NVP -based regimen	MOH changed policy and issued a facility memo to transition children and adolescents on NVP-based regimens to better regimens (either Lopinavir/ritonavir-based or Efavirenz-based)

-Eswatini PrEP modelling [28] -Uganda PrEP modelling [29]	Modeling projected cost-effectiveness and impact of PrEP in various target populations	MOH modified their choice of national priority target populations for PrEP in line with recommendations from the modelling.
Zambia ZAMFAM Benchmark [30]	Low proportions of OVC who had birth certificates; and OVC whose HIV status was known	USAID funded two IPs to facilitate issuance of birth certificates and increasing HIV testing for OVC.

Long-term impact (years-decades): changes in key indicators of HIV response, the 90-90-90s

The aim of Project SOAR studies is to strengthen programs that contribute to the global goals of ending the HIV epidemic through attainment of the 90-90-90 goals. Thus, the long-term impact of Project SOAR studies on the first 90, is to increase the proportion of people who know their HIV status. Contribution to the second 90 is to increase the proportion of PLHIV on ART and contribution to the third 90, is to increase those on ART who are virally suppressed. However, the time between publication of research results, the utilization of that research in decision making and clinical practice and then the corresponding reflection of those actions on population-based indicators varies and can be measured in years or decades. This time lag makes it difficult to document the long-term outcomes of research utilization [31, 6]. Secondly, the population level indicators of prevalence of knowledge of HIV status, ARV treatment and viral load suppression are impacted by other ongoing activities and programs therefore making it challenging to attribute the influence of isolated research utilization activities on the overall indicator improvement. For this reason, PEPFAR conducts Population-based HIV Impact Assessments (PHIA) [3]) to gauge and guide the entire HIV response in priority countries.

Discussion

Non-use of research findings

In our analysis above we have applied instances of use of evidence to illustrate initial and intermediate outcomes of SOAR's research utilization activities. However, research utilization, just like any program activity, has instances of failure to yield outcomes or instances of use. Documentation of research use should also include non-use of research and reasons why the research was not used. Reasons for non-use vary and can include that the study methodology was not sound enough, the study findings were not convincing enough—"intervention failure", or that the stakeholders were not optimally engaged either in the research process or in interpretation of the findings—research utilization failure [33]. Other reasons could be that the findings did not align with a decision-making moment, there was no mechanism within which to ask for or enact change, or there was no budget to enact the change. Indeed, it has been argued that documentation of RU should span the entire research and dissemination process to enable researchers and stakeholders to link research impact or non-impact to how utilization was promoted [6]. In SOAR, the six-monthly reporting template (Table 1) that captures activities to engage stakeholders and feedback from study investigators, provides a written record of RU activities throughout the life of the project thus providing information needed to further analyze what was effective and ineffective to generate research use. In the following section we discuss some of the challenges in monitoring research use illustrated by SOAR's experience where applicable.

Challenges in monitoring research utilization

Reporting bias

Documentation and monitoring of research utilization is susceptible to reporting bias. Most methods of data collection to monitor RU involve interviews with or by research generators and research

users [7, 3, 15], and hence are subject to recall bias as the respondents tend to recall only what worked. Or they are subject to social desirability bias because the respondents have a reason to please the interviewers or they have a vested interest to show the value of the investment made in research. Secondly, the selection of instances of research utilization that are reported tends to be biased towards "high-impact rather than low-impact" research [14].

Attribution

Attributing a policy or program change to a specific research finding is difficult if not often impossible. Research utilization activities are usually not implemented as a randomized controlled intervention; the results of a study are simply presented to decisionmakers without an experimental design to exclude other factors that could influence decision-making. Such factors include political forces and other external policy influences, good fortune, other studies and magnitude of the problem being addressed by the research finding [6, 31, 33, 15]. Further, there is usually no counterfactual; meaning that there is no way of telling what would have happened had the study not been conducted [29] or had the results not been presented to those particular stakeholders, at that particular time, in that particular manner and setting [7]. The closest we can get to attribution is when the change in policy or practice is made after the dissemination of findings to the specific stakeholders who made the decision. For example, after SOAR investigators presented study results to the national AIDS program in Senegal that showed the feasibility of HIV self-testing (HST) [26], the national AIDS program included HST in the national HIV test and start strategy. It could be argued that, without the SOAR study, the national AIDS program could have still included HST in its strategy; on the other hand, it could also be argued that SOAR's feasibility study provided confidence to the national AIDS program to implement HST.

Unpredictable time lag

The time between completion of research and its utilization varies widely. Some study results are used immediately after a study is completed, even before the results are published or it may take months or years for results to affect policy and programs. For example, in SOAR's study on the feasibility of HIV test and start in Namibia [20], the implementing partner (IP), used the data before the results were disseminated at a national meeting. The IP reported that, based on preliminary study data, the findings were so compelling that the IP had already implemented some of the recommendations such as differentiated ART for youth and reduction of frequency of clinician consultations for stable patients.

However, many research findings aren't used for years or decades after they were published [31]. With the possibility of infinite time lag between publication and utilization of research [6] it becomes difficult to document when a study's results have been used because often, after the study ends, the interested parties do not have the resources to continuously document and monitor instances of utilization. It is, therefore, impossible to conclude that the study's results have not, or will never be utilized. For this reason, SOAR investigators developed data use plans which include the identification and cultivation of champions who will continue promoting the use of study findings at opportune moments even after the end of project SOAR, as explained above. For example, in Malawi, where the epidemiologist commented that SOAR DREAM's research that showed a high prevalence of genital herpes among AGYW might influence the go/no-go decision about provision of PrEP to AGYW, our champion intends to follow up by attending the prevention TWG and discussing our results together with other data being used to make the go/no-go decision.

Conclusion and Recommendations

Funders of research are increasingly seeking to understand the impact of research and the various returns on their investment [1]. Moreover, as funding to support some areas of research wanes or remains stagnant, the need to document the value of investing in research by its' effect on improved programs and policies becomes increasingly necessary. It may be argued however, that given the lack of a counterfactual in research utilization, it is not possible for researchers to attribute a policy/program change to their study's findings. The authors recommend that as part of the study protocol development process, researchers need to assess the policy landscape related to the guidelines/policies the study is intending to influence. Such information can give support to the case for attribution when corroborated with the fact that the policy/program change was made after the research findings were disseminated to the specific stakeholders who made the change.

The time lag between researchers releasing results and stakeholders using the results to improve programs/policies is unpredictable and adds yet another challenge to robustly monitoring research utilization. It is, therefore, imperative that researchers implement systematic RU activities (as outlined above) including identifying and coaching in-country champions to promote study findings over time and to develop data use plans that define a roadmap for RU activities to guide the champions to promote study findings at future opportunities after study results are disseminated.

While monitoring of research utilization is not a widely established component of research, experiences in project SOAR have shown that researchers can use a simple set of tools and guidance to record activities they conduct to systematically ensure that stakeholders are aware of research findings and the intent and commitment from stakeholders to take programmatic or policy decisions. Research organizations should require researchers to routinely use RU reporting tools for all significant research investments. In addition, researchers and stakeholders are often biased towards reporting high-impact research yet important lessons about RU implementation can be learned from low- or no-impact research.

Therefore, monitoring should be conducted prospectively and not selectively retrospectively report only on research that showed impact.

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Figure 1. Logic model for SOAR's RU activities