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Multi-directional communication between decision makers and environmental health researchers: a qualitative inquiry

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Abstract

It has been three decades since key leaders gathered to pave a path toward healthier and more just environments and recommendations were made to improve communication between scientists and community stakeholders who can influence decision making. Since that time, community engaged research has flourished while building the capacity of researchers to engage in the work of making change to those environments has lagged. The purpose of this study was the development of guidelines to inform interactions between researchers and decision makers and influencers who participate in the policy change process. This community engaged, pragmatic and iterative inquiry includes insight from a review of existing resources and key informant interviews. Resulting guidelines were piloted, and formative evaluation by community stakeholders informed and resulted in refinement to the guidelines. Strategies for communicating and disseminating scientific evidence are presented as well as tactics that sensitise researchers to the nuances of policy makers' realities so they may serve as a resource for dealing with complex information and decisions. We provide tactics and archived resources in an on-line toolkit that we have cultivated

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over time to foster effective communication between scientists and those who have a stake in ensuring that decisions are evidence informed.

Keywords

Community engaged research; policy communication; environmental science communication; advocacy; public communication

Introduction

It has been three decades since key leaders gathered to pave a path toward healthier and more just environments and recommendations were made to improve communication and trust between scientists, health care professionals, and community stakeholders who can influence decision making (Anderson et al., 1993; USDHHS, 2015). Research funders have supported outreach and literacy initiatives, though meaningful and sustainable engagement by researchers in the work of making change toward more just environments has lagged.

Environmental hazards continue to emerge and evolve while at the same time, the rapid pace of research investigating the impact of exposures means that protecting the public through policy and regulation is increasingly difficult (Yin et al., 2021). Research training is not designed with lay audiences in mind, despite the fact that sharing information outside of academic venues and more broadly has implications for accelerating improvements in public health (Kuehne et al., 2014). Well intended researchers may provide recommendations about individual behaviour changes based on what they have learned, but policy development is the typically the only route to changing exposure conditions (Kuehne et al., 2014). Environmental scientists are not exposed to information about how to communicate with non-expert audiences, including policy makers, and are unprepared for encounters (von Schneidemesser et al., 2020). Calls from funding agencies including, for example, the National Institute of Environmental Health Sciences, highlight the need for improving science communication demonstrated by the requirement for community engagement specialists and those with expertise in health communication to be involved as collaborators.

Policy makers remain siloed from scientists who possess technical knowledge of environmental issues and associated health risks that can inform regulations, legislation, and the allocation of resources for preparation and response to hazards (De Marchi, 2007). By and large, policy makers (at least at the national level) do not have a background in the sciences (for a profile of the 117th Congress, see: <https://crsreports.congress.gov/product/pdf/R/R46705>). The majority of those members have held positions in public service and politics, do not have a background in science, and have studied law, education and business.

Policy decisions are made based on the best available evidence and influenced by political, economic and constituent concerns and have profound and long-lasting effects on people's lives. The COVID-19 pandemic has demonstrated the critical role that science plays in decision making and highlighted the importance of communication and cooperation among researchers and the public to respond to ongoing public health challenges. However, there

is limited evidence from the perspective of end users (policy makers in this case) about how best to impart information related to environmental science. Studies tend to focus on communicating about health with decision makers at the individual (e.g. patients, clinicians) or organisational level (e.g. hospitals), and rarely investigate communication matters at the policy level.

These dynamics highlight the need for insight on what may lead to effective interactions between researchers and legislators as well as stakeholders who participate in the policy change process (going forward we use an umbrella term, 'decision makers' to refer to legislators and stakeholders who are decision influencers, e.g. legislative staff, CBOs, advocates, etc.). Thus, we sought to address this gap to understand how to improve such interactions. We found little evidence that policy influencers and makers have been involved in shaping tools for improving communication, thus the novelty of this project was achieved in our close collaboration and in collecting evidence from those who contribute to the policy making process and have to grapple with complex evidence when making decisions about environmental regulations.

Description of community engagement in Environmental Health Science Core Centers

This examination focuses on bridging the gap between research and decision makers and in response to the increasing public calls for the democratisation of science as a public good based on our roles and commitment to environmental literacy, advocacy, and justice. The National Institutes of Health (NIH) and other research funding mechanisms have been variably responsive to the calls for community engagement in terms of the extent to which they emphasise equitable partnerships, versus, for example, community 'advisory' boards that invite community input but not decision making. In response to environmental and social movements that occurred in the 1980s, in 1994 President Clinton ordered federal agencies to develop strategies to address the disproportionate environmental burdens that faced marginalised communities (Northbridge & Shepard, 1997). That same year NIH, EPA, and several other agencies organised the Symposium on Health Research and Needs to Ensure Environmental Justice, a novel meeting where scientists, health care professionals, and residents worked together to outline a path towards environmental justice (USDHHS, 2015). Since that time the National Institute of Environmental Health Sciences (NIEHS) has been responsive to environmentally overburdened communities and required grant programmes to engage community stakeholders in their work. More specifically, NIEHS Environmental Health Science Core Centers (EHSCCs) must include Community Engagement Cores that actively engage members of communities. Several of the EHSCCs encompass explicit attention to engagement of policy and other decision makers, toward assuring the use of high-quality environmental health science to inform environmental decisions. Such Centres recognise the importance of maintaining relationships between environmental health researchers and policy and other decision leaders and makers. Being responsive to requests for experts is imperative to maintaining relationships, mutually beneficial support, and improved public health. The aims and activities of the Community Engagement Cores (CEC) at each NIEHS EHSCC is to foster partnerships with their respective community and to translate and disseminate environmental health research that can inform decision making from the individual to policy level. The CECs do this through

the development of community and stakeholder advisory and/or advocacy boards (CAB/SAB) made up of residents, advocates, and community decision leaders and influencers who ensure CEC activities reflect community concerns and priorities.

The objective of this study was the development of guidelines to enhance multi-directional communication between environmental health researchers and decision makers. Toward that end, this project was a collaboration among three EHSCC CEC teams at three Universities, two of which are located in Michigan and one in Texas, along with their community board members. This study is novel in that it aimed to understand forces contributing to the science-policy disconnect and responds to calls for insight needed to prepare researchers to engage in science-policy (von Schneidemesser et al., 2020; Wang et al., 2022; Yin et al., 2021). Moreover, we address the lack of perspective and missing voices of environmental advocates and policy makers, who are under-represented in the literature.

Our goal was to examine facilitators and barriers of effective communication to address this guiding question: *How can environmental health science be strategically communicated to promote the use of scientific evidence in decision making?*

Background: communicating science to decision makers

Scientists have a role to play in public decision-making and calls abound for communicating scientific information to inform decision-making, though researchers may not fully appreciate the importance of doing so (Besley et al., 2016; Fischhoff & Scheufele, 2013; Irion et al., 2012; Leshner, 2007, 2012; NASEM, 2017; Nisbet, 2011; Portier et al., 2007). In fact, scientific evidence is a key factor in determining what health issues legislators devote their time to working on (Dodson et al., 2013). Action is needed for all members of the public health community, including scientists, to engage in the process in order to ‘reverse the painful pace of environmental degradation’ and contribute to risk management and more just environments (Greenberg et al., 2020). Scientists have limited skills in communicating for social justice and engaging individuals who may use their expertise to make data-informed decisions (Dodson et al., 2013; Portier et al., 2007; Varner, 2014). Moreover, they operate in systems that do not reward engagement with non-academic communities and often discouraged to do so (Carragee & Frey, 2016).

Scientists who desire to engage in policy communication face challenges when they turn to academic literature for guidance. The first challenge is the divergent terminologies related to science-policy and communication; the second is the fragmentation and broad distribution of relevant articles across disciplines. Such studies were framed as bridging the science-policy divide or the science-communication gap, the former related to biology and the latter to biodiversity (Driscoll et al., 2011; Meinard & Quetiers, 2013). In other disciplines, two-way processes for interacting with policy makers were framed as knowledge exchange, transferring knowledge and translation processes (Lavis et al., 2003; Reed et al., 2014; Sampson et al., 2016). Elsewhere, environmental management and public health experts applied principles that, when baked into the research, informed strategies that impacted decision making. Experts of forest, ecosystems, and oceanic and atmospheric science have grappled with communicating and integrating their research with decision making, demonstrating the span across disciplines that the topic traverses (Jacobs, 2002; Janse, 2008;

Lavis et al., 2003). Such studies resulted in training tools, though communication experts caution against silver bullet approaches that focus on, ‘training scientists to communicate better’ (Raphael, 2019). In addition to the fragmentation of information across multiple disciplines, science communication training has been criticised for lacking a strategic approach, overemphasising technical skills and knowledge building rather than a clear, concise, and cogent presentation of complex information (Besley et al., 2013).

Although we did not locate best practices *per se* for policy communication, there are multiple ways to engage in dialogue about science-related issues and subsequently influence public opinion and policy preferences (Nisbet & Markowitz, 2015; Peterman et al., 2017). For example, studies have found that researchers can achieve greater impact through partnering with individuals who have expertise in communicating with policy makers, telling stories to enhance understanding of the issue, grounding the research in constituent experiences, and framing insight in a way that is compelling, arouses emotion, and can be recycled by policy makers for their constituents (Korfmacher, 2019; Lerner & Gehrke, 2018; Maibach et al., 2011; Myers et al., 2012; Stamatakis et al., 2010). Interactions are mutually beneficial for community stakeholders who have increased access to expertise, advocacy tools, and health promoting resources and information (Leach et al., 2022).

Method

The study design involved the use of qualitative data in an iterative process that drew on the literature as a foundation for and throughout our study, informed our research design and instrumentation, and provided a framework for interpretations (Merriam & Simpson, 2000). As shown in Figure 1, community stakeholders were engaged throughout the process. Building on the literature review, and through discussions, we determined that in addition to communication barriers, researchers who are funded by federal grants may be reluctant to engage in political activities because they do not fully understand the boundaries of advocacy compared with lobbying. In response, we developed a primer to reduce apprehension and delineate how to navigate legislative interactions ([access here](#)).

Interview methodology

Based on the literature review, we developed a protocol for semi-structured interviews with key informants. We did not conduct the interviews with *a priori* specific communication strategies; rather, we examined the facilitators and barriers to effective communication between environmental health scientists and decision makers. The semi-structured interview guide was used to stimulate discussion and allowed interviewers to adopt a conversational approach that allowed for spontaneity and flexibility (Lindlof & Taylor, 2002; Tracy, 2013). We developed a training protocol for conducting qualitative interviews and held a two-hour virtual meeting to sync procedures across the three study sites. After the study protocol underwent community member review, it was reviewed by each respective Institutional Review Board. We initially identified twenty-six potential key informants who were recruited using email and after scheduling meeting times and settings, the interview guide was emailed in advance for review. We received consent to audio record each conversation before they began. Interviews were completed between March and October of 2018 and

conducted in person, over the phone and virtually. The interview mode (e.g. telephone, web, face-to-face) was selected based on interviewee preference, and pragmatically, to reduce barriers to conducting the interviews especially for organisational members (e.g. staff, directors) and elected officials who were located at a considerable geographic distance from the interviewers (Oltmann, 2016). For example, several state elected officials' offices were located two or more hours from university interviewers. We interviewed nineteen individuals including: local and state elected officials and staff members ($n = 4$) including from the Texas House Parliamentarian and two State House of Representatives offices, e.g. Michigan and Texas; directors and staff members from community-based and advocacy organisations ($n = 9$) including the Michigan Environmental Council, Texas Health and Environmental Alliance, Detroit Food Policy Council, the Ecology Center, Air Alliance Houston, Texas Campaign for the Environment, and Eastside Community Network; government agency staff members ($n = 2$) including the Detroit Health Department and Michigan Department of Environmental Quality; and, legislative liaisons ($n = 3$) from two Universities and the National Conference of State Legislatures, and one Environmental Health Science Core Center Director. The interviews yielded 733 min of audio recording that lasted an averaging 38 min each.

Because 'one of the most important parts of transforming embodied interviews into usable data is transcribing' each interviewer transcribed their respective audio recordings (Tracy, 2013). Thematic analysis was conducted among the three teams after a brief training on coding. This scheme was based on the literature and an iterative process that involved coding and conversations among community partners and authors who shared their experiences, reactions, and expertise, and returning to the literature frequently as depicted by the longest arrow in Figure 1. Three interviewers independently categorised their interview excerpts into two broad themes, (1) communication (e.g. message, format, sender) and (2) dissemination (e.g. channel, mode). These broad themes allowed the group to determine what codes and definitions would be used to focus the analysis and how to fracture those data into second-level codes, which resulted in 'finer distinctions' made later in the analysis process (Tracy, 2013). After using an iterative process of individual site analyses and then coming back together in a series of meetings for in-depth discussions, the themes were narrowed. Community stakeholder review informed the interpretation and translation into the development of guidelines which underwent several iterations.

The guidelines were piloted by having respective community stakeholders review one-page, two-sided fact sheets and provide feedback using a formative evaluation process. The three sites then met for a debriefing discussion about how community feedback would inform refinement of guidelines. Examples of refinement included: (1) adding an introduction to the guidelines document to explain the purpose, (2) content edits [e.g. presentation should *align* with constituent concerns versus *address*], (3) re-ordering information to emphasise communication priorities, (4) separation of references to a hyperlinked separate document, and (5) encouraging a community review process (similar to academic peer review process). The final iteration of the guidelines was distributed for review by community partners at each research site.

Results

In general, participants indicated the need for increased interactions, 'There needs to be more dialogue between researchers and decision makers to understand each other regarding environmental justice issues.' They offered insights on how such dialogue would be impactful.

Localise information.

Participants frequently discussed the importance of research being communicated so that it addressed community concerns and cautioned, 'there is not a one-size fits all approach.' They suggested that researchers, 'think about what the information can do for the person you're speaking to,' and invited researchers to bear in mind that 'a policy maker has different information needs than a community member.' Dialogue and community involvement early in the process were recommended, 'Bring people in to talk about what you're doing, then the research can be matched to the questions of community members, they get localised, they are tailored to the concerns.' Early involvement would ensure relevant outcomes, as demonstrated by this comment:

I think having residents involved from the beginning would provide more insight into what information do they need, how do they want that information conveyed back to them in a way that is understandable, and then how do they need that information captured [at] the City Council level is just one example.

Participants were enthusiastic about obtaining information that would 'directly respond to the queries of [the] policy-making community' and build the capacity of local organisations to 'do the work to combat health inequities.' Participants noted the benefits of multi-directional dialogue among researchers, community stakeholders, and decision leaders and makers, and that 'connected research strengthens communities.'

Message delivery.

Participants emphasised ways to improve interactions and means for delivering relevant, distilled, comprehensible, and accessible scientific evidence. Brevity was prized: 'Avoid the super long papers or doing it, but then distilling it into something people can read sitting in a meeting or waiting for the meeting to start or sitting on the House floor waiting to vote. That's honestly where a lot of reading is done.'

The need to communicate efficiently was touched on by several individuals who discussed their hurried interactions with policy makers and their staff, as this recounted experience demonstrates:

I've been in the office of a legislator and had thirty seconds to talk before a loud buzzer sounded. The legislator stood up and walked out to go vote. You really have to think about what you want to say in those thirty seconds.

Participants advised against lengthy explanations of methodology when talking with legislators and suggested that researchers talk about their research results first as one government liaison explained, 'Think about a car commercial, the end result is shown. The

commercial doesn't talk about the research and design and the technical specs. When you're ready to buy, you might want to know.'

Resources that enhanced understanding – such as fact sheets – were identified as key communication tools relied upon when interacting with policy makers, as the following statement illustrates:

The one-pager is still the currency in policy-making circles despite the internet. The reason for that is that most decision makers are incredibly overwhelmed and will never do research like this [one-pager] on their own. So our goal is to do their work for them and present the most compelling findings in a concise way so that they can be our ambassadors in the policy-making process.

One participant provided details about the presentation and purpose of a useful fact sheet:

So, you want to have sections using bold, italics, underline, bullet points, white space. The whole idea is for the non-expert lay person to be able to pull out the most salient points pretty effortlessly and quickly, so they are able to look down and quickly digest what the issue is

Participants were critical of the science community whose materials are often, 'bogged down by sources and citations.' Suggestions for edits included adding an 'asterisk to indicate that information is available upon request and link the information electronically, so it is accessible.'

Message content.

The need for 'limited relevant communication' or distilled information from researchers was often accompanied by the need to use language that is 'stripped of jargon' and 'accessible, neutral, and simplified.' Academic culture was criticised for impeding public engagement, 'Academia rewards you for sounding smart. If you use plain language, they think you don't know what you're talking about.' Likewise, participants suggested that researchers should, 'know who your audience is and consider the reading level' so that the information is decipherable. If policy makers and their staff can't understand the problem, strategies to communicate about that problem will not be meaningful or useful (Kreuter & Wray, 2003). A common barrier cited when interacting with scientists was the deep pool of knowledge they had, as one participant explained, 'When you're so immersed in the topic, you don't see what others know.' Listening was a recommended communication tactic to address the tension between communicating for efficiency and the lack of foundational knowledge. As one participant stated, 'Give people a chance to talk so you know where they are at on the topic.' Listening provides an opportunity for researchers to understand what information is needed so that messages can be tailored to need.

Feedback.

Participants continued with the sub-theme that such interactions lacked an exact or one size-fits-all method of communication and that interactions with policy makers may take different forms at different points in time. There may be more opportunities for dialogue,

while at other times there may be a need for distilled information and responses to pointed questions.

Despite the variations that interactions could take, many participants expressed their preference for accessing scientific information through dialogue or other synchronous modes so that if they need to ‘better understand something, it’s good to be able to ask questions.’ Participants felt that, overall, ‘more dialogue means more understanding bi-directionally’ whether over the phone or through ‘one-on-ones, seminars, [or] workshops ... [they’re] good to move conversations forward and make improvements within our work ... and how we apply it.’ The benefit of bi-directional communication was explained by one participant who said, ‘The back-and-forth dialogue in person is helpful for asking questions like: What does that word mean? I don’t understand that acronym. You’re losing me here.’ Participants preferred synchronous communication which provided opportunities for mutual learning (Storksdieck et al., 2016) especially over uni-directional processes such as web-based communication or email, which this example illustrates:

Web-based information can be problematic. This also only tells part of the story and I want to learn more, so I may be interested in a different aspect than the writer. I will click through and will seek out additional information. These links [to journal articles] can also be blocked, there needs to be more access to communities.

Engaged sender.

Participants discussed the experience of interacting with scientists, for example, ‘It [working with researchers] can be pretty intimidating for the community member’ who may desire to engage researchers in the policy communication process. Basic interpersonal skills such as expressions of concern, making a connection, mutual learning, and listening for understanding (Nelson et al., 2009) may become salient as policy makers reach out to researchers who they would like to ‘be relatable, present your-self as a human.’ Storytelling was noted as a tool for humanising the researcher:

Personalize the research. How would you talk to your aunt about your research? She would want to know why you care ... Why do you do what you do? Where? What lab? Include pictures of the lab, students, field work, easy to digest graphics, and personalize your work.

Those who drafted legislation described the benefits of connecting with researchers, including having access to topic experts, demonstrated by this quotation: ‘When I’m trying to advocate for things, it’s helpful to have these kinds of people [researchers] who know more of the technical stuff, for me to be able to make the best argument both in legislation and around permits.’ They acknowledged that researchers may not know how to use their findings for community impact or benefit which could be remedied by talking to community boards and other stakeholders. Researchers were encouraged to give presentations to community and lay audiences, ‘Researchers speaking to [stakeholder boards] helps to keep them informed and thinking about how that information may benefit others who they know and gets their buy-in and support for the work.’ To reiterate what was stated earlier, participants advocated for researchers to engage with communities in order to

find, ‘ways to work together so that recommendations come out of the work, how it matters, [and] what is actionable.’

Academic-community conduits.

In the same way that researchers may not know who to reach out to, participants expressed frustrations about not being able to reach into a University: ‘I have a need for research, but I don’t know who to call and who does it well?’ Participants advocated for ‘more *conduits* between Universities and community organizations’ such as engagement or communication specialists. They noted that the specialists were skilled ‘information ambassadors that understand both sides; community and academic worlds to facilitate [dialogue].’ Participants valued the key conduits, particularly ‘someone [who] has the trust of community’ whom they viewed as translators who could ‘connect with the community ... that speak the language’ of both sides. These intermediaries (labelled *academic-community conduits* indicating a person who operates in-between scientists and policy makers) not only facilitated connections, but also helped to bridge communication gaps, hence the comment, ‘We need more translators. We need more bridge builders!’

Finally, it should be noted that one participant called attention to the potential increased impact of employing more than one communication strategy provided above to appeal to different learning styles and preferences, ‘I think it’s good that [evidence] is offered in different ways because people receive, interpret, and process information differently, and having a diverse way in which information is communicated is necessary.’

Discussion

Evolving hazards and scientific information combined with the proliferation of information sharing avenues (e.g. social media) calls for communication skill building among researchers so they have tactics and tools when responding to public concerns (Kuehne et al., 2014). There is widespread agreement that science should be disseminated outside of academic venues, however, this study is novel in that we investigated how science can be strategically communicated to promote the use of scientific evidence, specifically in decision making based on insight from key contributors to the process. Moreover, we partnered with decision influencers throughout this investigation from protocol development through the translation of findings into practical tools. Here we discuss how the results informed the environmental science-policy communication guidelines and best practices (see Figure 2 and Supplemental Files) and a web archive of science communication tools for researchers so they are equipped to interact with critical policy audiences. Along with aligning scientific research with constituent concerns, the presentation and dissemination of that information to policy makers, who are key stakeholders in creating more just environments and make lasting change through policy change (Korfmacher, 2019).

Align research with constituent concerns.

Consistent with environmental health communication models, the first recommendation focuses on the importance of connecting the research to the circumstances and environmental issues faced by decision makers’ constituents (Druckman, 2015). This aligns

with scholars who noted the importance of delivering content that is relevant to constituent concerns and a specific environmental issue, and it is recommended that researchers prepare for interactions by understanding those concerns (Guidotti, 2013; Varner, 2014). In fact, scientific evidence and constituent needs are the two most important factors influencing legislators' work on public health priorities highlights scientific evidence and constituent needs are (Varner, 2014). Recommendations were provided for researchers who may not readily understand how their work relates to a specific community, including engaging in dialogue with community stakeholders about the research as a means to learn how the content relates so that it can be tailored to those circumstances. Such public engagement with science can aid in localising information, and in cases where researchers do not understand specific constituencies, communication conduits such as government relations, communication, and community engagement specialists may be needed as ambassadors, bridge builders, and resources for anchoring findings (Druckman, 2015; Jacobs, 2002). When research is engaged with communities, it fosters environmental stewardship and justice and can increase the capacity for that community to advocate for health-promoting and protecting decisions against hazards (Baron et al., 2009; Lichtenberg et al., 2017; Minkler, Vásquez, Tajik, & Petersen, 2008).

Recognise knowledge differences.

Our findings are consistent with previous studies advocating for increasing the accessibility of scientific information that is communicated so that it is understandable in language that is less complex, stripped of jargon and acronyms, and distilled so that it is understandable (Bullock et al., 2019; Nelson et al., 2009). Listening was a key strategy for being able to tailor responses and fill in knowledge gaps (discussed below). Researchers are trained to defend their research, though communicating information so that it is understandable can be more meaningful and useful for making informed decisions.

Tailor responses.

Feedback is an essential facet of health communication particularly when literacy levels may vary, and complex environmental issues are the focus (Nelson et al., 2009). This may explain why synchronous media were overwhelmingly preferred. Synchronous interactions provide opportunities for researchers to listen and develop responses that combat misinformation, and correct misunderstandings and misconceptions; both of which may be as crucial for comprehension as emphasising facts, figures, or results (Dudo & Besley, 2016; Lerner & Gehrke, 2018; Leshner, 2007; Nelson et al., 2009; Sampson et al., 2015; Varner, 2014).

Develop one page fact sheets.

One-page fact sheets can serve as a key tool for advocacy and engaging decision makers, particularly when it accompanies a synchronous interaction. Printed fact sheets remain important communication devices that can be left behind to enhance understanding and when co-developed with community stakeholders, can ensure the content is useful (Izumi et al., 2010). Researchers should include their contact information in all presentations and materials so they may be a resource for addressing complex questions later, as Wang et al. (2022) suggest, 'Becoming a scientist in a policy maker's contact book opens the door for longer-term engagement opportunities when they need expert advice' (p. 17507). Providing

hyperlinks to accessible journal articles and moving citations to a separate document is ideal, this allows for more visually appealing images or white space.

Present research conclusions first.

The organisation of content is important when communicating science. Unlike traditional presentations of academic research, the findings should be communicated first (AAAS, 2021) to be sure that the most salient information is shared in the brief time that policy makers have to talk (Wang et al., 2022). This inverse approach to communicating science is most impactful for non-scientific audiences (AAAS, 2021; von Winterfeldt, 2013). We recommend that researchers offer to share foundational and established knowledge and methodological decisions upon request.

Use visual aids.

Visuals and personal stories during presentations and in fact sheets help make connections and humanise scientists and increase likability. Researchers were described as potential resources for interpreting complex information though not always viewed as approachable. Thus, including a picture of a lab, the researcher, and other visually interesting images can help to shape impressions and reduce apprehension to engagement.

Disseminate information outside of academia.

In line with Wang et al. (2022), researchers should seek out opportunities to communicate outside of academic venues so they develop an understanding of the needs and language of policy makers. Interactions with non-scientific audiences will allow researchers to understand better how they can contribute to social justice causes and sharpen skills as they 'learn by doing' (Wang et al., 2022, p. 17506) when they conversate without jargon or practice active listening (Bullock et al., 2019). This may include communicating or participating in community meetings, via blogs or social media, or helping to create practical tools derived from their findings which can help translate science for improved community health and decision making (Bullock et al., 2019; Janse, 2008). Including contact information (e.g. email, lab webpage, phone number) during presentations and on materials such as brochures and fact sheets, is recommended so that the researcher may be contacted for future decisions and deciphering complex information, as stated above though worth repeating.

We theorise that utilising a multicomponent approach may have greater impact than any single strategy. We hope that this manuscript will add to the empirical understanding of how researchers, policy communicators, translators, and others can work together to improve interactions and experiences when communicating with policy makers, and that as a result, policy will be more evidence informed.

Lastly, a recommended strategy by more than one of our community stakeholders was for researchers to develop materials based on these guidelines and invite community stakeholders to review for usability and understanding, similar to peer review. We have collected and archived a toolkit of resources and materials on a webpage including an evaluation tool for community stakeholder review of translating scientific information to a

fact sheet (see Supplemental Files). In our experience, the tools, materials, and resources webpage have been helpful in preparing researchers for non-scientific interactions, and hope that others will access and benefit from the evolving collection.

Limitations.

This study is limited in many ways. These communicative aspects do not account for the other types of communication including the literature that addresses risk communication and the psychological processes involved in decision making based on addressing either beliefs or values (von Winterfeldt, 2013). This study and the resulting guidelines are limited by the number of participants and limited geographic variance, with interviewees located in just two states. Though the involvement of community stakeholders in this research added to the validity of our findings, additional research with participants reflecting a broader range of contexts, and a greater number of interviewees would enhance the reproducibility and scalability of the findings. Future directions may include developing and evaluating training based on the results and examining the efficacy of those findings.

Conclusion

Though the guidelines may be useful for communicating scientific evidence for decision making, the matter of who should carry the responsibility of translating science for public use remains unresolved. Some suggest that the responsibility lies with the researcher, while others suggest that the institutions where the research takes place are culpable though hiring and tenure promotion systems do support such efforts (Rother, 2014; Varner, 2014). Moreover, ethics boards and funders should consider the implications of leaving overburdened communities who contribute to research, uninformed about the outcomes. Community stakeholders play an important bridging role between researchers and policy makers who are siloed, though they are inextricably linked in that they face society's most complex and challenging issues. Researchers may proactively engage communication, public relations, and community experts who can further prepare them to play an active role in improving the lives of people, especially in under-resourced and over-burdened communities who need allies in their efforts to bend the health equity arc toward environmental justice.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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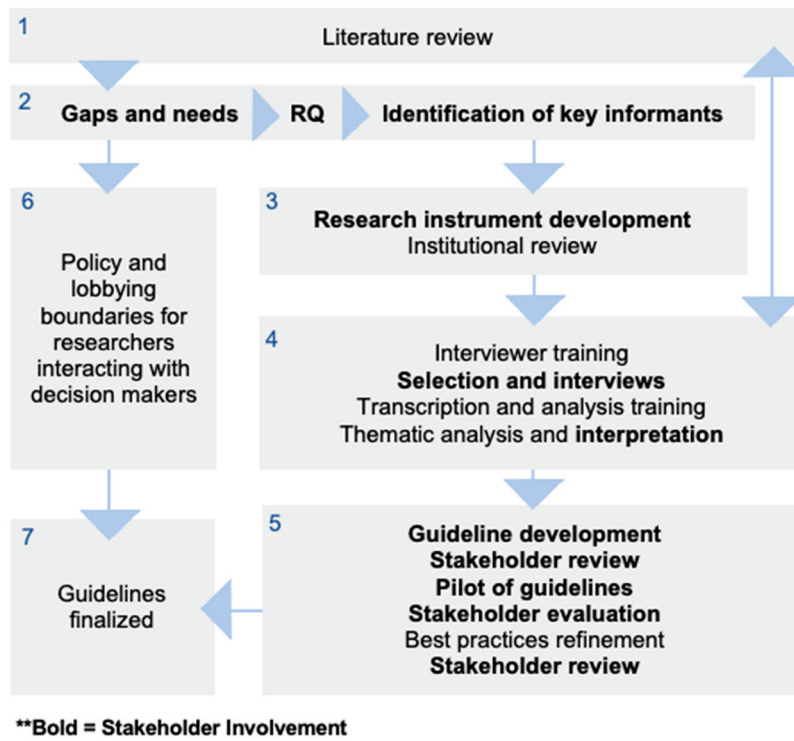


Figure 1.
Research methodology diagram.

Best Practices: Sharing Environmental Health Research

"There needs to be more dialogue between researchers and decision-makers to understand each other regarding environmental justice issues."
- Activist

Results from environmental health research can inform efforts to prevent and solve environmental health challenges. This document synthesizes existing science communication literature with insight from decision maker interviews to offer guidelines for translating and sharing environmental health research. We learned that decision makers including activists, community-based organization leaders, government and elected officials and their staff want more opportunities to engage with researchers.

The best practices include remarks from key informants who helped develop them.

Align Your Research with Constituent Concerns
Learn about your audience. Consider how your research aligns with the environmental health concerns of their constituents.

Present Research Conclusions First
Lead with the most salient information. Typically delivered at the end of a scientific presentation, the **Public Communication Model** below suggests beginning with the bottom line when communicating with non-research audiences. Starting with research conclusions is a key strategy for delivering scientific evidence.

Background
Supporting Details
Results / Conclusions

RESEARCHER

PUBLIC

Supporting Details

Recognize Knowledge Differences
Part of getting to know your audience is understanding the knowledge that they bring to the table. For many, beginning with basics will be appropriate (e.g., define terms such as "epigenetics"). Be prepared to be flexible and responsive to the knowledge base that your audience has.

- Continued -

Advocating for a Healthy Environment

Guidelines for Engaging Policy Makers

"Think about what the information can do for the person you're speaking to. A policy maker has different information needs than a community member. There is a not one-size fits all approach."
- Decision Leader

"Less is more, give me the compelling information up front."
- Legislative Liaison

"I've been in the office of a legislator and had thirty seconds to talk before a loud buzzer sounded. The legislator stood up and walked out to go vote. You really have to think about what you want to say in those thirty seconds."
- CBO Leader

"Start with the assumption that people have no background information, start at the beginning of what you learned"
- Activist

Figure 2. Tools for interacting with decision makers.

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