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Cultivating a culture of inclusivity in heliophysics

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A large number of heliophysicists from across career levels, institution types, and job titles came together to support a poster at Heliophysics 2050 and the position papers for the 2024 Heliophysics decadal survey titled "Cultivating a Culture of Inclusivity in Heliophysics," "The Importance of Policies: It's not just a pipeline problem," and "Mentorship within Heliophysics." While writing these position papers, the number of people who privately shared **disturbing stories and experiences of bullying and harassment** was shocking. The number of people who privately expressed how **burned out** they were was staggering. The number of people who privately spoke about how they **considered leaving the field for their and their family's health** was astounding. And for as much good there is in our community, it is still a **toxic environment** for many. If we fail to do something now, our field will continue to suffer. While acknowledging the ongoing growth that we as individuals must work toward, we call on our colleagues to join us in working on organizational, group, and personal levels toward a truly inclusive culture, for the wellbeing of our colleagues and the success of our field. This work includes policies, processes, and commitments to promote: **accountability** for bad actors; **financial security** through removing the constant anxiety about funding; **prioritization** of mental health and community through removing constant deadlines and constant last-minute requests; **a collaborative culture** rather than a hyper-competitive one; and **a community where people can thrive as whole persons** and do not have to give up a healthy or well-rounded life to succeed.

KEYWORDS

workforce, science policy, informal education, diversity, evaluation and assessment, mental health, inclusivity, culture

1 Introduction

This project started with a conversation about the need for efforts and investments in the culture and community aspects of Heliophysics [1]. With 2 days before abstracts for Helio2050 were due, Katherine Garcia-Sage and Alexa Halford reached out to their networks and asked if others would like to be involved with a poster centered around this concept. They asked initially for only three things; 1) Sign up as a co-author if you agreed; 2) Reflect on these issues and try to apply best practices in your daily work/life; and 3) Pass this request on to your colleagues who may be interested in participating. The sizable fast response (120 + coauthors) shows two things. The first is that many within our community believe and are dedicated to making our community better. The second is that using a word of mouth network misses people who would like to be involved and have similar interests and expertise that missed being able to be included. While in many ways this project has been a success, it has also shown the need for more open practices to be taken. This paper reflects and adds to what was submitted as a white paper to the Solar and Space Physics (Heliophysics) 2024-2033 Decadal Survey. Specifically we have added our thoughts on what individuals can do to help create a culture of inclusivity. Actions individuals can take to improve our culture include:

- Continue to actively reflect on our individual biases.
- Continue to learn and seek out ways to improve our understanding and empathy.
- Hold ourselves and others accountable - become a better ally.
- Be willing to engage in the tough, uncomfortable conversations required for growth.

The 2024 Heliophysics decadal survey will help guide the Heliophysics community to create opportunities for future success. A uniquely fundamental question will drive science innovations and discoveries in the coming decades: What kind of a research environment and community will we build? The most innovative scientific ideas and discoveries develop in safe, inclusive, diverse, accessible, and collaborative environments [2–13]. These environments strengthen all types of collaborations and advance innovations in concepts and applications. If we ignore these critical aspects of science, current issues regarding diversity, retention, and succession will persist. This paper discusses current critical problems and introduces actionable steps that can promote a culture of inclusivity.

The recommendations and best practices discussed within this paper are a starting point to help our community cultivate a more welcoming and open culture. Achieving this goal will require continual work. Additionally, we must have clear policies and hold ourselves and our institutions accountable. Finally, we must continue to communicate and revise our policies and norms as we learn how different actions, structural elements, and community policies hinder or help individuals to fully and freely engage within our scientific community.

Science, Technology, Engineering, and Mathematics (STEM) in general are fields whose communities reflect only a small portion of the potential talent available from the broader population. The most recent publicly available demographic survey for Heliophysics was completed by the American Geophysical Union (AGU) [14]. The Space Physics and Aeronomy (SPA) sections of AGU, which encompass a large portion of the Heliophysics community, have fewer non-male participants than most other sections. Anecdotally, non-white participants are also strongly underrepresented, as seen in most STEM fields [13,15]. This lack of diversity hurts our field and inhibits innovations by not fostering a culture where all voices are heard, respected, and valued [16–18].

Like all other humans, scientists can only start engaging in creative and innovative thinking after all of the deficiency needs (physiological, safety, love and social belonging, and esteem) have been met [19]. Within this series of position papers, which stem from the Heliophysics 2050 poster [1], we have identified some of the more substantial roadblocks to achieving an environment where the best science can be accomplished. We look to experts inside and outside our field who have identified best practices to mitigate and remove roadblocks that create deficiency needs. **We recommend that the institutional leaders adopt these best practices, encourage their use at the individual level through structural incentives and by setting a personal example, and continue to evaluate and improve these tools as we learn more.**

2 Code of conduct and shared values

With such a large team, we, the authors and co-authors, adopted a set of shared values and a code of conduct to help facilitate discussions and work on the original poster, the position papers, and finally, with this peer reviewed work. We share those below and encourage others to take, improve, and share their codes of conduct and shared values with others.

2.1 Code of conduct for the development of our collaboration

We believe this collaboration should maintain a professional, positive, and inclusive experience for everyone, even in a virtual environment. We are committed to providing a friendly, safe, and welcoming environment for all colleagues. We expect everyone to treat each other with respect, dignity, and courtesy. We expect that people will refrain from demanding or discriminatory behavior and speech. Everyone should be mindful of their surroundings and remember that this workplace is where professional interactions are expected and should be the norm. Unacceptable behavior includes intimidating, harassing, abusive, discriminatory, derogatory or demeaning conduct. If there is an issue that arises or you become aware of, please let Alexa, Katherine, or other trusted individuals within the collaboration know. Keep in mind that when communicating virtually, many clues we typically derive from nuances of emotion, tone, and body language are lost. This makes it all the more important to consider the content and tone of contact and communication to avoid misinterpretation or miscommunication. Respect copying and use of presented materials and ideas as indicated by AGU's Guidelines on Photography and Social Media, including knowing when you may need to obtain permission regarding copying materials. And in the end, be Accountable: When we as team members fail to meet these guidelines, we will work together to identify problems and adjust policy and practice together.

2.2 Shared values

This code of conduct is derived from our shared values and aims to support and enable these values:

- **Inclusion:** Innovative, creative, and robust science and deep knowledge integration is completed through effective collaborations where all voices are valued and included.
- **Diversity:** As our interdisciplinary teams bring different perspectives, new methodologies, and experiences together, we can more effectively accomplish translational breakthroughs to our science objectives.
- **Honesty:** Identification of the limits of what can be derived from our current physical understanding, data, and methodologies to improve our scientific understanding and how our science impacts our lives.
- **Self-reflection and accountability:** We acknowledge that we all carry our own biases and that we are human and imperfect. With this understanding, we acknowledge that self-reflection and disclosure to ourselves of our own biases and holding ourselves accountable can help us become better mentors, collaborators, and ultimately better scientists.
- **An environment of trust:** In order for the free exchange of new innovative ideas, there needs to be an environment and culture of trust. While we feel that the above values and guidelines should cultivate this environment, it is essential to state that trust within the team is highly valued to ensure a healthy and safe collaborative ecosystem.

We encourage the development of other shared values for teams and collaborations and are looking to add one ourselves. We see a need to explicitly value active listening, where we work to listen patiently and attentively, using our own experiences to empathize and sympathize with the speaker.

3 Cultivating a culture of inclusivity and openness

Our ability to foster a culture where innovation and great science can be accomplished is intimately tied to our ability to perform at peak potential. This requires that everyone can participate, and freely and safely share ideas and research. While it may hurt some in our community to hear this, for many individuals, our field is not a psychologically or physically safe place, and that is directly reflected in our current demographics. However, we can improve, learn, and grow.

3.1 Creating a safe and welcoming environment

Improving the culture in our community is the right thing to do, period. However, as we work towards increasing diversity in our field, we must simultaneously ensure that our field is a safe place for people to act. If we do not, people will continue to leave our field, and find fulfilling work in environments where they can thrive. Ultimately, it is empathy that is the necessary trait to foster and cultivate good collaborative team environments and strong collaborations [20–22]. This includes becoming active bystanders and supportive colleagues as we see macro- and micro-aggressions. Below we address issues that currently make our community exclusionary to some, as well as explicit activities and best practices that we can adopt to make our field more inclusive, improving scientific creativity and innovation.

Recommended action: Individuals and institutions with authority (e.g., NASA, NSF, AGU, and universities) must actively and intentionally look beyond the own lived experiences (e.g., with respect to culture, religion, race/ethnicity, gender identity) to understand the reality of experience of others, especially if somebody belong to a marginalized group.

3.1.1 Continued examination of our behavior, actions, and words

We need a continued examination of our own individual biases, behaviors, and actions along with the structures, actions, and words coming from our institutions. This can be as simple as reflecting and checking our implicit biases when we have significant impacts, such as during panel and paper reviews, inviting speakers, and nominating people to positions and for awards. In addition, we can take some fundamental steps to help mitigate our own and our institutions' biases. Here are a few specific suggestions: Adopt anti-racist principles/best practices, Adopt best practices to minimize bias (explicit and implicit), and Establish codes of conduct and safety plans. As an example, the 2019 and 2020 SPA Fellows nomination committee, chaired by Dr. Halford, worked to identify groups we may have biases for or against (original list can be found at [23,24] and the current list is below). This list was created for the discussions of the nominations, so that the committee could check-in and remind themselves about the biases we all hold, and reflect on whether they had impacted the discussions and rankings. The current list includes the following:

- Gender
- Nationality
- Race
- Career level (as defined by AGU retired/senior/expert vs. mid-career vs. mid-career/expert/senior)
- Extrovert vs. introvert (speaks more at conferences vs. doesn't speak up at conferences)
- Well funded home institution/country vs. less advantaged institution/country (e.g., ability to be seen at conferences and visit other scientists vs. fewer opportunities for visibility and networking)
- Academic institution vs. government/corporate research institution
- Large mission participation vs. smaller projects such as CubeSats, rockets, balloons etc.
- Experimentalist vs. theorist
- Resorting to shortcut metrics (e.g., h-index), which moves away from discussing the substance
- Bias towards own subfield
- Individuals who publish/work in a small group and/or are often the first author vs. those who work in large collaborative groups and/or mentor others to be first authors/PIs
- The Matthew Effect: A paper or result being attributed to the most notable person in the author list, not the person who did the work or the first author [25].

- The Matthew/Matilda effect: Men tend to get the credit or more credit than women, who did just as much or more of the work [26].
- Disability

As we continue to examine our biases and our culture more items should be added. As an example, while writing this paper it was noted that "Disability" was not included in our original list. Thus, we have added and acknowledged this bias here. We are certain that others are also missing and we encourage continued reflection and amendments to this list.

3.1.2 Types of biases and harassment

There is a need for continued examination of our biases, behaviors, and actions along with those structures, actions, and words coming from our institutions. Some of this is done by making sure we reflect on and check our own implicit biases when we are in a position that can have a large impact, such as during panel and paper reviews, when inviting speakers, and when nominating people to positions and for awards. There are many types of bias and harassment; we define some common forms below:

- *Explicit bias* makes another person feel unwelcome because of an individual's deliberate words and actions to exclude them.
- *Implicit Bias* takes place when an individual's words and actions are unwelcoming, yet the person is unaware that they are being exclusionary.
- *Microaggressions* are small actions and words that make others feel unwelcome, and whose consistent presence cause lasting harm.
- *Macroaggressions* are large-scale or overt negative actions towards an entire group of people.
- *Harassment* comprises actions that make other people feel unsafe.
- *Bullying* is harassment where an individual coerces another one to do something they don't want to do.

Biases and harassment often are upheld by *systematic policies and practices* that benefit one group over another [27,28]. These biases and harassment can occur in concert, amplifying the negative impacts experienced by the targeted individual or group.

3.1.3 Addressing bias and harassment

It is vital to make the point that intentions cannot be seen. Just like when you accidentally bump into someone, or step on their feet, you stop and apologize recognizing the physical harm you did to them. The same must be true for the mental and psychological harm we do, unintentional or not. Thus **intentions do not matter, impact matters**. While an individual causing the harm may not have intended to do so, and can learn and grow from the experience, we cannot ignore the injury to the victim Utt [29]. We *ALL* have areas in which we can improve. Below are some simple recommendations for how to work towards removing and mitigating the impact of bias beyond recognizing that harm was done and apologizing:

- Microaggressions: Increased bystander intervention training and fostering a culture of calmly yet immediately confronting them [28].
- Macroaggressions: Sustained conversations promoting the evidence that diversity and inclusion of all groups leads to better outcomes. Effective reporting and accountability measures implemented by funding agencies and societal organizations are necessary to mitigate and remove macroaggressions.
- Harassment: Clear and easy reporting procedures followed by serious investigations of alleged abuses and accountability when abuse has been found to occur.
- Bullying: As bullying stems from abuse of power over others, implementing systemic checks and balances to power can minimize the influence of bullies.

3.1.4 Respect of and collaboration with diverse communities

There is a real need to nurture environments that respect and collaborate with diverse communities, recognizing and valuing their expertise and viewpoints. Many people feel uncomfortable joining a room/community/field, where the others don't look like them (described as a repulsive force) [30]. To overcome this natural tendency, we must actively work towards creating a more inclusive and diverse community. However, when reaching out to other cultures, we must recognize that if we force them to choose between their culture and being a scientist, they will choose their culture, and we lose them from our field [31].

3.1.5 Recognition of the unique challenges faced by first generation students

First-generation college and Ph.D. students unfamiliar with academic/research culture face many challenges. Beyond not knowing academic culture norms and how to navigate academia, first-generation students may lack (family) support systems familiar with STEM field practices. For instance, many non-academic families assume that graduate school means more college debt, they do not understand the academic career path, and they have no appreciation for the stresses of it.

We must ensure that local support networks are available and advertise existing resources such as the McNair Scholars program. Additionally, mentoring can cover issues that would not be obvious to someone from outside the academic culture. Examples of topics covered might include helping undergraduate students prepare for graduate school, discussions on the variety of available career paths, and what to expect when attending meetings, or advise on how to travel domestically and internationally.

3.2 Tracking and working towards representative demographics

AGU has improved on tracking demographics among its membership as well as publishing the results, but more institutions need to follow suit [14]. Gathering demographic information in a safe manner requires expertise in survey design and analysis. However, these statistics are vitally important for defining a starting point and allowing us to track our progress.

Recommended action: Agencies (e.g., NASA and NSF) and professional societies (e.g., AGU) should employ social science experts to track demographics and report findings in a transparent manner.

3.3 Life-work balance and blending

People of diverse backgrounds are more likely to have adverse experiences, which cause a strain on mental health, and reduce socioeconomic opportunities [32,33]. Even if the workplace has changed dramatically over the past decades, we continue to perpetuate many stereotypes and expectations that are actively harmful and push people away from the field: The rundown graduate student [34]; The postdoc who works nights and weekends to get enough papers and grants to land that permanent position; The singly-focused scientist who works 90 h a week to submit the next proposal at the expense of sleep, recreation, and family. We have, intentionally or not, elevated and encouraged these scientist stereotypes to our own detriment, [6,10].

The glorification of working heroic hours has led to mental and physical health issues, undue stress, broken families, and suicides. Furthermore, there is little evidence that, in the long term, the best science is achieved within such an environment [35–37]. Continuous stress is known to reduce creativity and innovativeness, and haste leads to increased number of mistakes [2–13]. Unfortunately, we drive talent away from the field by accepting these stereotypes as standard and virtuous in the scientific workplace—too many of us have witnessed talented colleagues depart science to careers where the hours are shorter and pressures are lower [38]. For all of these reasons—health, happiness, and productivity—we need to recognize that work-life balance is an issue of vital importance for our field. Other cultures have shown that scientific progress can be made without such a toxic work culture and constant burnout [39].

Creating a culture where people can feel secure and less stressed leads to increased creativity, innovative science, and simply more results [40]. Below we identify and address some of the issues which can help develop a healthy work-life balance.

3.3.1 Value of outside, non-work activities

We must move the conversation forward from life-work balance towards creating fulfilling lives. Normalizing downtime outside of our work activities is also essential to producing innovation. Social activities outside of work should be recognized as healthy and supported. For example, physical exercise is vital for mental and physical health and should be encouraged and supported [41]. Our brains need rest to process what we have learned. When stepping away from a project, having a break in our workshops, our brains are not idle but are provided space to make new connections. As those new connections are made, discoveries are found - the "Ah-ha" moment we have while daydreaming or running come from providing our brains space to process challenging problems.

3.3.2 Active steps to avoid isolation

People tend to interact socially both at work and after work with people they feel comfortable with. Unfortunately, this can result in underrepresented groups being excluded from important connections or networking opportunities. In the extreme, the majority's preference of staying within their comfort zone can lead to a climate phenomenon of "invisibility." Veronica Hill, one of the DEIAJ (Diversity, Equity, Inclusion, Accessibility, and Social Justice) leads at NASA Goddard, has discussed how working with new and diverse people can be uncomfortable. We need to lean into that discomfort—avoiding it makes the climate worse.

3.3.3 Resources to support caregivers

Currently, there is a lack of support for researchers who are caregivers or face life disruptions. The ability to take time off, sometimes for extended periods, to address family life events such as family expansions, illnesses, and deaths is critically important for the wellbeing of the individual and their families. Moreover, such flexibility pays off as increased productivity following a well-managed crisis situation.

But the everyday family lives need to be equally recognized and supported. One of paramount importance is dependent care, including available and affordable infant and child care, support for childcare at work and conferences through grants, as well as accommodating lactation needs. The pandemic in particular made clear the importance of family sick leave when dependent care was failing because facilities closed, had limited capacity, or caretakers could not provide or dependents could not recieve the care due to health needs. While everyone can benefit from family support systems, the career impacts following from lack thereof are not equally distributed. Child care is a prime example of issues that impact the child-bearing individuals. As our field already has an identified issue with supporting people other than cis-men, this is an area we need to acknowledge and address [41–43].

3.3.4 Resources for mental health

More resources need to be allocated to catching mental health issues earlier and to providing better support for scientists. We also need to foster a more open culture that would allow discussing these stresses and to get peer support. We need to shift from a culture of labeling talking about stress as "whining" to one that recognizes it as the reality. Solutions might include more open discussion about mental health, better access to mental health services, and individuals and institutions checking in with colleagues and co-workers.

Recommended action: Individuals and institutions with authority (e.g., NASA, NSF, AGU, and universities) must provide the needed flexibility and resources to individuals who, temporarily or on a continuing basis, must invest increased attention in their lives outside of work.

3.4 Burnout

Burnout is common within academia, and it has an enormous impact on our ability to excel [44]. Long hours, unreasonable deadlines, meeting overload, and other working culture issues contribute to burnout without improving the pace or direction of scientific progress [40]. According to Ellen Hendriksen, burnout has three symptoms: emotional exhaustion, reduced effectiveness, and de-personalization (e.g., being cynical, critical, and resentful) [45]. These qualities perpetuate toxic work environments: The (already) toxic environments are more likely to have stressors that lead to burnout, and the symptoms of burnout contribute to development of toxic environments. Below we discuss some of the issues that lead to burnout.

3.4.1 Unreasonable expectations and overlapping deadlines

Unreasonable and overlapping deadlines inhibit deep creative thinking. People feel pressured to work outside of office hours, feel that they are failing at meeting their potential, and feel that they did not have time for development of new ideas, new research, or write actual research papers. Constant operation in an environment where everything is an emergency or mission-critical leaves no downtime to stop and think. As the situation creates a constant feeling of failure, people will not have time, energy, or confidence in their abilities to suggest new and innovative ideas. Marginalized groups are less likely to possess tools to combat these feelings, which may cause traumatic experiences that reduce their feeling of self-worth.

We need to develop a culture with a transparent and honest assessment of realistic deadlines. **This frank assessment needs to include discussion of the number of work hours required to complete the task, discussion of the workload of individuals including expectations to and impacts of work beyond a 40-h week, and realistic consequences of slipping deadlines.** In addition, we as a community need to start prioritizing mental and physical health and including this in deadline assessments.

3.4.2 Meeting overload

Meetings are an essential tool in any group working toward a common goal. They are a way to check in, transfer knowledge, and identify any issues which may be coming up. They can also be fantastic forums for brainstorming and collaboration. However, too many meetings can lead to burnout and "zoom fatigue" [46]. Unproductive meetings waste time and lead to drained feeling afterward.

As science is global, we often work in geographically dispersed teams, which leads to an abundance of online meetings. The pandemic and recently expanded telework has also increased the need for more virtual meetings. The ease of calling a meeting at any time can lead to a false sense of urgency around all discussions, which brings a fear of "missing out" and desire to remain "relevant" through participation. These factors conspire to make meetings a source of unhappiness and burnout.

3.4.3 Expectation of required, unpaid overtime

The stereotype of a scientist often consists of a laser-focused person dedicated to their research. Their love for their research is above everything else, and they will sacrifice everything—including their health, family, and financial security—to find the next big breakthrough. Unfortunately, while we can all point to individuals for whom this seems to work, we can point to many more who suffer from burnout and either leave the field or are continually miserable. A key problem is that the budgets of externally funded projects frequently are built on the expectation that employees will regularly work more than 40 h per week. Space missions are often under-funded in their development phase considering the scope of the work required. The PIs cannot involve the number of Co-Is that would be necessary to reasonably split the workload. Budgets are too tight to allow PIs to hire and retain experienced professionals while supporting, training, and advocating for students and junior research scientists. Mission PIs must often outsource work to industrial consultants, who are typically paid more than those working within the academia, only because their institutions do not have the funding to retain permanent employees with the needed expertise.

While there will always be times and situations when extra hours are needed, this should not be the norm. We must as a community have honest discussions over the number of work hours needed to complete a task, whether it includes asking people to work beyond a 40-h week for extended periods, and what will happen if the deadlines or projects slip. We must start prioritizing our communities' mental and physical health and include this in the assessment of projects, funding, and deadlines.

Recommended action: NASA and NSF should help establish realistic expectations of workload for individual projects and provide adequate budget allocations for all funded projects to ensure reasonable work efforts for all investigators. These expectations (of work and funding) should be defined through self-reflection and open discussion with the community.

3.5 Developing an inclusive culture and dismantling culture and practices that push people out

As a field, we are relatively good at encouraging people to enter space physics. However, the above discussion shows that there are many ways how people are pushed out. When people are left out, discouraged, and unable to participate, they will find other fields which allow them to thrive. However, there are more ways in which we actively push people out. What may seem like a minor thing (such as not having a place to identify your gender in a survey) can feel like you are not allowed to exist in this space.

Those with both visible and invisible disabilities face additional challenges in navigating the current norms in the field. Students and postdoctoral researchers often are not eligible for comprehensive healthcare insurance at their institutions, making access to the necessary care challenging. Cultural practices such as last-minute networking over dinner or drinks can be prohibitive for those with accessibility needs. Finally, workplaces, laboratories, and conferences should be designed, adapted, and planned with consideration of those with special needs [47]. These changes will have a positive impact and allow equitable participation without a constant need for extra consideration.

Recommended action: Individuals and institutions with authority (e.g., NASA, NSF, AGU, and universities) must make events, workplaces, and resources accessible and welcoming to those with physical or mental disabilities, immunocompromised individuals (and those who regularly interact with them), those with caregiving requirements, and individuals from minoritized groups, without placing upon those people the burden of continually making those requests or the need to disclose sensitive information about themselves.

4 Concluding remarks

There are five elements to achieving DEIAJ in a community: individuals, groups, organization, compliance, and communication. It helps to have everyone onboard. At the institutional level, practices must be transformed, and infractions must be dealt with promptly and consistently.

1. Individual-level: It is very difficult for a collaboration group to be inclusive and equitable if the individuals are not committed to it. Leaders can help, but the climate is determined by interaction with one's peers. Therefore, **education and training is key for individuals to understand the factors involved, identify the manifestation of impediments to DEIAJ, and have clear and effective strategies to counteract them.**
2. Group level: DEIAJ at the group level ensures people have access to opportunities and play a significant, valued role. The **adoption of 'Science of Team Science' and other best practices provide strategies to understand, identify, and mitigate impediments to a diverse, equitable, and inclusive environment at the group level** [48].
3. Organizational level: **Proposal reviews, performance evaluations, hiring, promotion, etc. are all practices that must adopt explicit strategies to counter bias.**
4. Compliance: **Enact a clear policy of behavioral expectations with explicit actions for violations.** Identify the process and people with the trust, knowledge, and authority to effectively address problems and resolve issues.
5. Communication and growth: Everyone is different, and what is not offensive to one person may be offensive to another. What makes one person feel included may make another feel discouraged. Therefore, **activities that promote communication and understanding, including conflict resolution, should be adopted at all organizational levels. Periodic surveys, anonymous reporting, and methods to evaluate community health need to be adopted.**

Author contributions

AH wrote the initial draft and led the further development of the manuscript. AB, MJ, TP, KG-S, CB, RA, NT, ML, LBW, AM, and SKV contributed to editing and revising of the manuscript. AM, LW, RM, CD, and RA contributed to the White Papers led by AH, which content is partly include here. All authors contributed to the article and approved the submitted version.

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Conflict of interest

RM was employed by Orion Space Solutions.

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