Organisational best practices towards gender equality in science and medicine

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In August 2018, the president of the World Bank noted that "'Human capital'—the potential of individuals—is going to be the most important long-term investment any country can make for its people's future prosperity and quality of life". Nevertheless, leaders and practitioners in academic science and medicine continue to be unaware of and poorly educated about the nature, extent, and impact of barriers to full participation of women and minorities in science and medicine around the world. This lack of awareness and education results in failures to fully mobilise the human capital of half the population and limits global technological and medical advancements. The chronic lack of recruitment, promotion, and retention of women in science and medicine is due to systemic, structural, organisational, institutional, cultural, and societal barriers to equity and inclusion. These barriers must be identified and removed through increased awareness of the challenges combined with evidence-based, data-driven approaches leading to measurable targets and outcomes. In this Review, we discuss these issues and highlight actions that could achieve gender equality in science and medicine. We survey approaches and insights that have helped to identify and remove systemic bias and barriers in science and medicine, and propose tools that will help organisational change toward gender equality. We describe tools that include formal legislation and mandated quotas at national or large-scale levels (eg, gender parity), techniques that increase fairness (eg, gender equity) through facilitated organisational cultural change at institutional levels, and professional development of core competencies at individual levels. This Review is not intended to be an extensive analysis of all the literature currently available on achieving gender equality in academic medicine and science, but rather, a reflection on finding multifactorial solutions.

Introduction

Women are underrepresented in academic science and medicine, particularly in leadership positions, as well as specialised (and better paid) areas of medicine such as surgery. Data from the Organisation for Economic Co-Operation and Development show that the overall proportion of female doctors has increased from 29% in 1990 to 46% in 2015, suggesting a trend towards increased participation of women.[1] However, the variation in participation rates across countries continues to be striking, suggesting a substantial impact of local social norms and cultural influences.

Although rates of participation may vary across countries, organisational climate and culture play important roles in attracting, retaining, and promoting women and girls in science and medicine. For instance, the Royal Society of Chemistry's recent report,[2] *Breaking the Barriers*, describes a context of funding uncertainty, an inflexible and unsupportive academic culture, and gender-stereotyped expectations of family and home care as barriers that limit women's progress in chemistry in the UK. In the USA, a substantial report by the National Academies of Science, Engineering, and Medicine[3] describes a pervasive, persistent, and damaging culture of harassment that limits participation and advancement of women in science, technology, engineering, and mathematics (STEM), which is echoed by Canadian data.[4] The intense personal costs to women of this culture are reflected in the motivations behind the #MeTooSTEM movement, which has provided a space for women to share their stories and advocate for change. The absence or exclusion of women from this culture also represents a cost to society of intellectual capital. Organisations must look to their culture and climate to address this lost potential.

Organisational climate can be defined as the meanings ascribed to that organisation's policies, practices, and procedures, and should reflect and support organisational culture, defined as the shared values and beliefs that influence workplace and employee behaviour.[5–7] Climate and culture must be addressed together because efforts to build a good climate will be unsuccessful if the policies conflict with the beliefs, assumptions, and values of an organisation; conversely, a positive culture will not produce the desired result if policies and procedures are not organised around the collective goals and beliefs.[8] Thus, addressing and improving organisational culture and climate in science and medicine are essential if women are to feel welcome, safe, supported, successful, and respected in these disciplines and if girls are to see their aspirations of careers in science and medicine as tangible options. Many advocates, including women in

academic science and medicine, are tired of initiatives that focus on women as being the problem, and which assume a masculine heteronormative view of the world, requiring women to achieve a set of behaviours and measures that have been defined, determined, and continue to be measured by systems that are inherently sexist and racist by design. The various barriers that comprise the glass obstacle course[9] for women in science, such as gender stereotyping and tokenism, have been well described.[10] Here we discuss effective strategies to shift organisational culture and climate towards gender equality using approaches that include legislation, allyship, leadership by scientific societies, professional development of core competencies in equity principles, and inclusive leadership. We note (but do not discuss) that organisational change towards gender equality in science and medicine is part of the broader societal challenge of reducing gender stereotyping of girls and boys and empowering men to embrace gender equality as a goal that also serves their interests.

Changing organisational culture and climate

For any organisation, the ultimate measure of an effective equity, diversity, and inclusion (EDI) strategy is the attainment of durable and sustainable cultural change guided by the specific needs and perspectives of equity-seeking groups. EDI is therefore best understood as a journey, not a specific destination; while progress can and must be measured at predetermined milestones, the driving principle must be widespread acceptance and pursuit of the hypothesis that an organisation can and must become ever more equitable, diverse, and inclusive.

Effecting meaningful EDI change in a medical or scientific environment, in either the public or private sector, can be particularly challenging because individuals nurtured in academic and health-care settings typically prioritise objectivity, social consciousness, and (often illusory) notions of equitable meritocracy. These individuals therefore find it insulting to be told that they need to recalibrate their objective world view or acknowledge and address their prejudices. There continues to be a pervasive opinion within the science and medicine communities that abilities in mathematics and science differ according to gender, and these attitudes are continually having to be challenged, often by women and members of under-represented groups. While there is no evidence for gendered differences in ability,[11] members of the scientific and medical communities are resistant to accepting evidence of gender bias and racism in science[12] and medicine.[13] Indeed, in working to advance gender equity in science policy in our own areas, we have heard repeatedly how this means lowering the bar on excellence.[14]

Scientists can also demonstrate unsound scientific thinking in support of their personal views on why women are under-represented (and not qualified to participate) in their fields. In September, 2018, an Italian theoretical physicist proposed in a talk at the European

Organisation for Nuclear Research (known as CERN) that women are inherently less capable in the field of high energy physics. This event prompted an impressive collective rebuttal from the broader community. A statement that highlighted evidence of long-standing systemic bias and exclusion of women in physics was signed by hundreds of scientists from the field of high energy physics and related disciplines. Opinions on why women are under-represented in science and medicine, when presented as being scientifically grounded, are particularly damaging when publicly professed by individuals in positions of leadership.

The more persistent and pervasive experience of many women in science and medicine is the claim by members of the dominant group of meritocracy as the explanation for the under-representation of women.[15] The myth of meritocracy is as entrenched in academic science and medicine as it is in Silicon Valley and Wall Street. Those who continue to believe the combined myths of meritocracy and equity[16] in science and medicine thus feel oppressed by initiatives aimed at achieving equality, resulting in pushback that can be retaliatory and hostile. Therefore, engaged leaders who actively and visibly challenge long-held beliefs around gender and merit are essential, particularly male leaders and those with power, privilege, and social capital. Otherwise, women who confront these beliefs might encounter a double dose of hostility; one for being present in science and another because of the confrontation itself.[17]

Recent research confirms the social and personal costs of confronting sexism in STEM-related disciplines (Hennessey E and Foster M, unpublished) and some of the data from these studies have been presented as innovative photo-research exhibits entitled #DistractinglySexist and #DistractinglyHonest in both academic and non-academic venues. Dialogue and feedback generated from these installations indicated that they have created a space for diverse groups, including all genders, to discuss sexism in science.[18] Thus, an important part of effecting change in science and medicine, beyond dialogue, will be leaders, influencers, policy makers, and male colleagues listening to women, without comment, and believing them as they share their stories and experiences.

It might also be useful to make women's contributions visible and try to normalise diversity (including but not limited to gender) in science and medicine through intentional celebration of initiatives such as International Pride in STEM day and #BLACKandSTEM. Creating safe spaces for conversations about diversity in science and medicine must be an explicit goal in improving organisational culture and is a key responsibility of academic and medical leadership. Leaders at all levels can also send clear messages indicating that the workplace values women by recognising and celebrating the contributions of diverse women to science and medicine at a small, local level or at a large institutional level. For example, Ada Lovelace Day allows institutions to connect

globally in celebrating the achievements of all women, past and present, in science and medicine, through talks, panels, workshops, parties, or other events. Data on the impact of these initiatives on organisational culture are scarce, and further studies on these approaches are clearly needed. However, it does appear that positive representations of women scientists can positively influence how younger women view their future professional identities.[19]

Inclusive leadership as a driver of organisational change in academic science and medicine

Achieving gender equality in academic science and medicine through evidence-based, milestone-driven changes in organisational culture and climate is the approach proposed by the UK's Athena SWAN Charter, which provides extrinsic validation of institutional projects through peer review. Regardless of how organisational cultural shifts happen, it is essential that the burden of work does not fall on under-represented groups, typically women, and those who are the most motivated to seek workplace cultural change (ie, those already facing the so-called minority tax).[20] This burden is amplified across intersectionalities, creating additional work for black and indigenous people of colour, people with disabilities, and members of the LGBTQ2S+ (lesbian, gay, bisexual, transgender, queer or questioning, 2-Spirit, and other sexual and gender minorities) community in having to continually justify their presence in the workplace and the value of their contributions.[20] The ability to recognise and remove the minority tax is a measure of inclusive leadership. Moreover, contributions towards cultural change should be taken into consideration in evaluation processes for key performance indicators, since failing to recognise the work involved can result in resentment, cynicism, and ineffective action plans.[21] The professional development of core competencies relating to EDI, particularly in leaders, is important. Successful and sustainable programmes require committed resources (including financial resources), which can include (but are not limited to) teaching release for faculty staff involved, the hiring of administrative support staff, and formal recognition of contributions to the process as part of workload. It is critically important that members of the dominant group (typically white, cisgender men) take an active, visible, and positive role in developing these types of key performance indicators and metrics, especially as leaders and advocates.

We believe that inclusive leadership is increasingly needed to effect organisational change, from the level of committee chairs and departmental chairs, to deans, presidents, vice chancellors, and principals. Inclusive leadership is already recognised as an essential aspect of effective leadership in business (panel 1).[22] Therefore, academic institutions stating that EDI is an institutional priority should ensure their leaders in science and medicine, regardless of their gender, have core competencies in

this area (eg, cultural intelligence, and self-awareness of implicit bias and gender stereotypes).[23] Inclusive leaders will establish and enforce hiring criteria that assess self-awareness and core competencies in the application of the principles of EDI, despite the evident challenges and resistance in science and medicine that have been well documented.[24] Integrating EDI training into scientific and medical curriculums at undergraduate and graduate level as standard practice, along with the expectation that competency in these areas will be required to progress in these fields, will help establish EDI awareness as a cultural norm for the workplace in both science and medicine. Many of these actionable approaches have been well described,[25] suggesting that not knowing what to do is no longer an excuse for any individual, leader, institution, or organisation.

Inclusive leaders are those who engage in thoughtful self-reflection. However, this is a valuable core competency for all members of scientific and medical communities. Self-awareness is also a key element in changing behaviours, either at the individual or institutional level. Increasingly, institutions, divisions, federal funding agencies, review and hiring committees, and professional development programmes are encouraging or requiring individuals to learn about their own implicit bias using tools such as the Harvard Project Implicit test. However, raising awareness of implicit bias is not sufficient to address systemic challenges[26] and indeed, there is a danger that completion of this training will be grouped with other checkbox initiatives (eg, health and safety) with which community members must comply. Implicit bias training is limited,[27] but moving towards core competencies in EDI being essential for hiring, merit and promotion within an organisation might incentivise members of the community and shift behaviours beyond mere compliance (panel 2).

Accountability is an important driver of organisational change and is essential in driving appropriate behaviours in some contexts. For example, the "30% comply or

For more on the **Athena SWAN Charter** see https://www.ecu.ac.uk/equality-charters/athena-swan

For more on **Project Implicit** see https://implicit.harvard.edu/implicit

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Panel 1: **Organisational change in action: a case study of inclusive leadership**

Shift Health is an example of small-scale organisational change being implemented through an intentional approach. Increased equity, diversity, and inclusion (EDI) was defined as a strategic priority by leadership and this was communicated to all members of the organisation. This communication was accompanied by a defined action plan that accounted for the individual needs of members of the organisation who had different perceptions, presumptions, levels of awareness, and scepticism. The action plan included opportunities for continuous feedback and monitoring, as well as measurable goals that included (but were not limited to) diversity targets, measures of employee satisfaction, staff retention, and advancement. Specific actions included intentional team building towards a shared understanding of EDI principles and actions, the redaction of features that identify gender or ethnicity on resumés, and adoption of new policies around work (such as flexible and individualised return to work plans following family leave, and open vacation policies). While it is early to determine the impact of these actions, the initial response from employees suggests increased satisfaction and more diverse recruitment.

For more on the **WISE Campaign** see https://www.wisecampaign.org.uk

For more on **Male Champions of Change** see http://malechampionsofchange.com

For the **Ada Initiative Conference Code of Conduct** see http://confcodeofconduct.com

For more on **Keychange** see https://keychange.eu

For the **allmalepanels blog** see http://allmalepanels.tumblr.com

For more on the **GenderAvenger initiative** see https://www.genderavenger.com

For more on **allyship** see http://www.guidetoallyship.com

explain" directive from the Ontario Securities Commission in Canada, introduced in December 2014, was intended to encourage companies to increase the proportion of women on their boards to 30% over the subsequent decade but resulted in no change by the end of 2018 because companies were simply able to state that they could not find qualified women (ie, the meritocracy myth).[28] We can only speculate on what the outcome might have been if the directive had stated "30% comply or be fined".

Role of academic societies

Given the challenge of shifting organisational culture within scientific and medical establishments, there is an important role for scientific and medical societies nationally and globally to demonstrate leadership in advocating for gender equality. Major scientific and medical societies (such as national academies, royal societies and international associations) should present a united voice on the need for EDI in science and medicine. Explicit statements challenging gender essentialism and highlighting the absence of evidence for gender-based differences in mathematics or science ability[11] can be helpful in shifting attitudes and opinions within and beyond the societies' boundaries. There is precedent for this approach, since numerous national scientific academies and global scientific and medical organisations have made explicit formal statements on the overwhelming evidence for anthropogenic climate change (eg, International Union of Concerned Scientists), evolution (eg, AAAS and equivalent organisations in other countries) and the public health benefits of vaccination (eg, WHO and partners). In addition, every scientific and medical society should be committed to producing gender

equitable and inclusive conferences, in terms of speakers, panels, organising committees, and attendees.[29] It is worth noting that achieving positive change is the responsibility of all members of a society, not just the women and under-represented members. Society-sponsored or supported conferences, and particularly those that are supported by public funding (eg, federal, national, provincial or state research funding, publicly funded or publicly assisted post-secondary educational institutions, and health-care systems), should commit to, and require evidence for, gender equity in addition to conference codes of conduct as part of a standard prerequisite for financial support. Industry or business partnerships with scientific and medical conferences should also have these expectations as part of standard corporate social responsibility (following examples by other sectors, such as Keychange in the music industry). Organisations and societies that fail to deliver diverse and inclusive conferences need to be held accountable. Social media platforms can swiftly bring negative attention to non-diverse meetings, such as the allmalepanels Tumblr page, which highlights panels, seminars and similar events where all participants are male. Initiatives such as GenderAvenger provide a safe platform for those who would otherwise potentially experience retaliation by calling out their own communities.

Allyship

Since leaders only comprise a small proportion of communities in science and medicine, we believe it is incumbent on all members of these communities at all levels to learn how to be allies. Allyship has proved to be a useful tool in the fight against harassment and bullying in several settings such as schools.[30–32] Allyship is an action rather than an identity, and everyone can be an ally for others. For instance, it could involve speaking up in support of women, amplifying their voices, and calling out discrimination when it happens rather than remaining silent. Effective allyship requires self-awareness, hard work, practice, humility, respect, commitment, and accountability. Interventions by trained allies can be instrumental in supporting underrepresented groups and improving workplace culture. There are some well developed learning programmes around allyship that could be modelled for science and medicine. Institutional programmes, such as the Advocates and Allies[33] programme that has been adopted by a number of US institutions, might be models of best practice in terms of gender equity. Interestingly, allyship talks, programmes, and training in support of increased equity and diversity in STEM are increasingly present as part of graduate training in STEM, helping all members of the community to develop core competencies that will improve the workplaces of the future.

We propose that allyship training is likely to be most effective when framed as part of organisational change that recognises who has and who abuses power and

privilege (to unfairly advantage themselves and people from the same group) in the workplace. Moreover, we propose that allyship training should highlight the role and responsibilities of all members of the community, regardless of gender, ethnic origin, sexual orientation, ability, or age, in supporting and advocating for other members of the community.

While allyship is a valuable tool, it is essential to recognise that impactful allyship training in any discipline must emphasise self-awareness, cultural humility, and be sensitive to intersectionalities. Indeed, classically defined allyship might not be the preferred route for cultural change, as proposed by the writer Roxane Gay: "Black people do not need allies. We need people to stand up and take on the problems borne of oppression as their own, without remove or distance. We need people to do this even if they cannot fully understand what it's like to be oppressed for their race or ethnicity, gender, sexuality, ability, class, religion, or other marker of identity. We need people to use common sense to figure out how to participate in social justice." Moreover, allyship in support of indigenous peoples requires a commitment to listening to, learning about, and accepting difficult and painful truths, then taking actions that are informed and led by those communities.[34]

Legislative approaches: quotas

We have proposed several voluntary tools for organisational change towards gender equality in science and medicine but it is also important to discuss legislated approaches, such as the use of quotas (ie, targets for the proportion or number of women that are required to be recruited within an organisation or department). The concept of using quotas to achieve gender parity in science and medicine typically elicits a strong and adverse response with claims that quotas are antithetical to a meritocracy. A Swedish study published in 2017 sought to address whether quality of work declined within the context of the Swedish political system in which quotas have been in place for local candidates for several years.[35] The analysis suggested that quotas raised the competence of male politicians when female representation was increased. Thus, the least competent men were most likely to lose their positions following an influx of women into politics, indicating that quotas are not at odds with a meritocracy but rather improve overall levels of competence. Some specific disciplines in which women are chronically underrepresented have introduced a quota-based hiring process (eg, Faculty of Engineering, Computing Science and Mathematical Sciences, University of Adelaide, Adelaide, SA, Australia).[36] This quota-based hiring process could speed up progress towards gender equality but it is likely to be seen as a challenge to the status quo and a perceived loss of power by the dominant group. The use of formal or legislated quotas is limited in academic science and medicine, particularly in Europe and North America. However, quotas are used to promote gender equality in South Africa.[37,38] Therefore, the Global South could provide insight into the use of quotas within a broader system-wide approach that includes legislation, governance and economic development.[39]

Sub-Saharan Africa scores 0·569 on the Gender Inequality Index, making it the region where women face the most gender inequality in reproductive health, education, political representation, and the labour market (South Africa has a score of 0·389).[40] Gender inequality in sub-Saharan Africa is, as with many other regions, largely linked to lower educational attainment and lower income (due to unemployment or employment in jobs at low pay grades). However, gender power inequalities, high rates of gender-based violence, and a disproportionate burden of disease (particularly HIV) are factors that compound the problem.[41] Although this remains an issue for the majority of women, sub-Saharan Africa has made notable progress in improving female representation at the leadership level. In southern Africa, 29% of senior leadership roles are held by women, which is a higher proportion than in some high-income countries such as the UK (19%) and Australia (23%).[42] In 2008, Rwanda became the first country in the world to have over 50% female representation in its parliament. Rwandan women have the same property rights as men, and girls have the same access to all levels of education as boys. The country has also shown a strong emphasis on challenging gender-based violence and encouraging girls to attend school,[43] demonstrating the need for a multifactorial, systemic approach to achieving gender equality across sectors.

South Africa made progress in addressing gender and racial representation in 1994 by acknowledging equality of the sexes, recognising women's rights, and providing support for transformation of workplaces through the Employment Equity Act (No 55 of 1998).[44] The act dictates that all designated employers (>150 employees) must submit an annual report that describes aspirational proportions of men, women, and racial groups in each level of the workforce. The rationale is that employment equity can be a work in progress but that goal setting helps to speed up the transformation. South Africa additionally makes use of voluntary quotas that are implemented alongside racial quotas in the national Black Economic Empowerment policy. A combined race and gender mechanism is appropriate in a country where, because of the historical legacy of apartheid with pervasive gender inequality, black African women are substantially more disadvantaged than in other groups.[45]

Through mapping voluntary, constitutional, and legislated quotas across southern Africa, the 2013 SADC Gender Protocol Barometer shows that in local government and in parliament, countries with quotas have a higher representation of women (37% and 38%, respectively) than those without (16% and 9%, respectively).[37] The Women Empowerment and Gender Equality Bill was passed by the South African National Assembly in March 2014, but because of some serious concerns the

legislation was referred back to parliament for further consultation.[38] It is not known whether gender quotas will become law in South Africa in the foreseeable future. The legislation, if it becomes law, would probably be the most radical gender quota legislation in the world, forcing all organisations, corporations, and government departments to have decision-making bodies comprising 50% women.[39] Some believe that the reliance on voluntary quotas rather than legislated quotas is making a difference and therefore the Women Empowerment and Gender Equality Bill is no longer warranted. In a review of three prominent mechanisms to increase the appointment of female directors, namely mandatory board gender quotas, voluntary targets and shareholder activism, legislation was thought to be the least preferred mechanism to promote board gender diversity, and voluntary targets and public pressure from shareholders were considered more effective.[46]

South Africa has made considerable progress in the 24 years since it became a democratic country and has been described as a success story for bringing women into employment through the use of voluntary quotas. Black professional women form the fastest growing segment of the South African workforce, and there are a growing number of black women who are prioritising their career over traditional roles.[47] Despite these gains, gender inequality persists. Although women in South Africa account for 43·8% of the total employment population, they still disproportionally dominate in the informal sector (47·6% of women compared with 30·6% of men).[48] They are largely absent in managerial positions, in which only one in three are women,[48] and in science and technology, in which only 20% of registered candidates with the Engineering Council of South Africa were women in 2013,[49] and African women account for only 12% of both humanities and science researchers.[50]

Studies suggest that for minorities to have their voices heard as an influential body, and for cultural change to take place, representation needs to be about 30% or higher.[51] Although 44% of the South African Parliament is female, only 20% of board directors, and 11% of chief executives in South Africa are women, and representation in senior leadership increased by only 2% between 2004 and 2017, which mirrors international trends.[52]

Conclusion

Achieving gender equality in science and medicine requires a wide set of tools to be available so that the most appropriate tools for the local context can be selected. Perhaps most importantly, those using these tools must be trained appropriately. In academic science and medicine, there is a lack of knowledge and competency in terms of how to effect organisational change towards gender equality. A deep understanding of the mechanisms by which organisational culture and climate can change, within and beyond academic science and medicine, must become a core competency. This understanding is particularly important for leaders, who must have broader skill sets than those specific to their discipline or to traditional forms of leadership and management. Additionally, training programmes in science and medicine (from undergraduate onwards) must include awareness and education around gender stereotypes, intersectionalities, and the value of diversity in improving outcomes in science and medicine. All of these activities will take place within a broader societal culture that continues to gender stereotype women and men, limiting collective human potential. Realising the full potential of our human capital is an essential driver of innovation[53] and economic development. Creating a community of scientists and medical professionals who can recognise and challenge the societal norms that limit inclusion should be the new norm, and we must expect and demand better of our scientific and medical colleagues and leaders. We need evidence-based policy changes and action plans, at multiple levels, to address and remove organisational, institutional, structural and systemic barriers to full engagement and participation of women in science and medicine. We must be guided by best or leading practices locally and globally. We need leadership, awareness, education, actions, intentionality, accountability and, perhaps most of all, courage.

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