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Practical Paper

Reaching those left behind: knowledge gaps, challenges, and approaches to achieving SDG 6 in high-income countries

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ABSTRACT

Even as progress has been made in extending access to safe water and sanitation under the Sustainable Development Goals (SDGs), substantial disparities in water, sanitation, and hygiene (WASH) services persist in high-income countries around the world. These gaps in service occur disproportionately among historically marginalized, rural, informal, and Indigenous communities. This paper synthesizes results from a side session convened at the 2020 University of North Carolina, Chapel Hill, Water and Health conference focused on knowledge gaps, challenges, and approaches to achieve SDG 6 among marginalized communities in high-income countries. We provide approaches and next steps to advance sustainable WASH services in communities that have often been overlooked.

Key words: high-income countries, hygiene, sanitation, water

HIGHLIGHTS

- HICs face similar challenges to LMICs in access to WASH, including reaching rural communities, building capacity, maintaining infrastructure, and improving water quality.
- Historically marginalized communities are heavily impacted and massive socio-political change is needed to eliminate inequities.
- HICs must improve access to services by filling data gaps, changing policies, and removing unjust social structures.

GRAPHICAL ABSTRACT

INTRODUCTION

The era of the Sustainable Development Goals (SDGs) has seen continued progress toward global targets for access to safe water, sanitation, and hygiene (WASH). SDG 6 aims to 'Ensure availability and sustainable management of water and sanitation for all.' Worldwide WASH coverage has climbed at a rate of approximately 0.5% per year for basic or safely managed drinking water and 1% per year for at least basic sanitation between 2000 and 2017 (Joint Monitoring Program 2020). As of 2017, 89.6% of the global population is estimated to have access to at least basic drinking water and 73.5% is estimated to have access to at least basic sanitation (Joint Monitoring Program 2020). These trends reflect coordinated efforts by governmental, international, and aid-based organizations that have contributed to 1.8 billion people gaining access to drinking water and 2.1 billion gaining access to sanitation since the year 2000 (Joint Monitoring Program 2019).

Despite this progress, significant inequalities still exist in WASH access (Anthonj *et al.* 2019), including in high-income countries where 6.2 million people were estimated to still rely on untreated surface water or unimproved drinking water sources and at least 9 million more lacked piped water in 2017 (Joint Monitoring Program 2020). Similarly, 8.4 million people were estimated to lack access to even basic sanitation in high-income countries in 2017 (Joint Monitoring Program 2020). These inequalities persist despite high-income countries' commitments to achieving universal water access by signing on to the SDGs (Kumar *et al.* 2016; Publications Office of the European Union 2018). In the United States (U.S.), these gaps in access have been associated with race. American Indian, Alaskan Native, Black, and Hispanic households are more likely to lack indoor plumbing (Deitz & Meehan 2019; Meehan & Jurjevich 2020). Even where piped water supplies and basic sanitation do exist, problems of poor water quality, inadequate quantity, and unsafe waste management are often found among low-income, historically marginalized, and minority populations, as documented among Indigenous Canadians living on reserves (Anthonj *et al.* 2019); remote Indigenous communities in Australia (Hall 2019; Hall *et al.* 2020); Tribal Nations (Eggers *et al.* 2018) and Alaska Native communities in the U.S. (Mattos *et al.* 2021); itinerant and sedentary Roma communities across Europe belonging to diverse groups including Sinti, Travellers, Kalé, and *Gens du voyage* (Van Hout & Staniewicz 2012; Davis & Ryan 2016; Anthonj *et al.* 2020); displaced persons (Araya *et al.* 2019), migrant communities (Semenza *et al.* 2016), and refugee camps (Dhesi *et al.* 2018; Tsesmelis *et al.* 2020) in Europe; rural and peri-urban Black communities in the southern U.S. (Stillo & Gibson 2016; Flowers *et al.* 2019); Hispanic communities along the U.S.-Mexico border (Rowles *et al.* 2020) and in California's San Joaquin Valley (Balazs *et al.* 2011); and people experiencing homelessness (Capone *et al.* 2018; Frye *et al.* 2019).

Despite the growing awareness of this reality in high-income countries, the populations that remain without safe water and sanitation services are often 'invisible' to, and thus underserved by, local and national governments. With the estimated water and sanitation coverage in high-income countries exceeding 98% in 2017 (Joint Monitoring Program 2020), the remaining 2% can easily be forgotten or ignored. In addition, current Joint Monitoring Program (JMP) metrics for characterizing WASH access fail to capture disparities in the reliability, quality, and affordability of water and sanitation services. They overlook problems associated with private water supplies such as private wells, which are vulnerable to contamination and may provide only intermittent service (Lockhart *et al.* 2020; Rowles *et al.* 2020; Hunter *et al.* 2021); failing onsite wastewater systems, which may contaminate local surface water and groundwater supplies (Kohler *et al.* 2016; Schaider *et al.* 2016; Yang *et al.* 2016); and lack of affordability, which can lead to water shutoffs (Ifill & Montag 2019). As a result, the true magnitude of WASH inequities in high-income countries

is unknown. Nonetheless, there are many case studies that document the health impacts of these under-recognized inequities in high-income countries. Examples from recent literature in the U.S. include reliance on private well water in Wake County, North Carolina, leading to a 25% increased odds of elevated blood lead levels in children (Gibson *et al.* 2020), poor sanitation in Alabama linked to an increased burden of disease from intestinal parasites (McKenna *et al.* 2017), and lack of handwashing access contributing to increased rates of COVID-19 among the Navajo Nation (Schmidt 2020; Kakol *et al.* 2021). Concerted efforts are needed to cover the 'last mile' and overcome the structural barriers to safe WASH access in these contexts. In addition, efforts are needed to characterize the magnitude of inequities not adequately measured by the JMP.

Recognizing the need to respond to WASH challenges in high-income nations, organizers from the University of California Merced, the University of Colorado Boulder, the University of North Carolina at Chapel Hill (UNC), Loma Linda University, Indiana University–Bloomington, the University of Twente, Swiftwater Solutions, Dig Deep, and the International Association of Plumbing and Mechanical Officials (IAPMO) convened a session at the annual UNC Water and Health Conference on October 27, 2020 entitled 'Getting left behind: Ensuring high-income countries achieve water and sanitation for all by 2030 (SDG6).' The goal of the session was to convene a network of researchers, practitioners, community representatives, and policymakers focused on WASH in high-income country contexts to identify areas of shared experience, challenges, and need. The results below summarize the major themes and priorities as outlined by participants of the session. Citations are provided to refer the reader to additional scholarship on each topic that emerged during the session but are not intended to indicate that the findings are the result of a systematic literature review by the authors. The subsequent discussion section synthesizes the session results into recommendations and action steps for future research, policy, and practice. Thus, this practical paper aims to inform high-income country governments, academics, water and wastewater professionals, and the broader WASH community on future priorities and collaborations needed to achieve universal, equitable WASH coverage in high-income countries.

METHODS

The session was conducted virtually through the online 2020 UNC Water and Health Conference. Of the 130 session participants, 67 responded to an online poll to characterize the background and experience of those in attendance. Of these, 52 (67%) were from the U.S., six (9%) were from Europe, five (7%) were from Canada, and four (6%) were from countries in Latin America, Asia, Africa, or the Pacific. As such, the knowledge gaps and challenges discussed were largely U.S. focused, highlighting the need for additional knowledge exchanges among professionals in high-income countries. The majority of participants were scholars, practitioners, and professionals in WASH. Most participants did not live in communities that lacked WASH access but had experience working with these communities.

The session began with brief pre-recorded presentations from three invited speakers who have personally experienced and worked with 'left behind' communities. These were Ms Cecelia Brooks, a Samuqwan Mi'kiju (Water Grandmother) with the Canadian Rivers Institute and former Director of Research and Indigenous knowledge for Mi'kmaq Chiefs of New Brunswick; Ms Jennifer Newby, a resident of the historically Black Irongate Drive neighborhood in Apex, North Carolina, which had long faced problems of inequity in water quality and quantity, compared to neighboring areas; and Ms Nataly Escobedo Garcia with the Leadership Council for Justice and Accountability. Participants then selected one of six virtual break-out rooms for discussions. The break-out room topics were focused on four distinct contexts where communities have been left behind in high-income countries (Indigenous populations, rural WASH, urban/peri-urban WASH, homelessness) and two cross-cutting challenges (aging infrastructure and affordability).

Within each break-out group, facilitators led a discussion focused on: (a) the knowledge and data gaps that participants have identified in their work; (b) challenges that participants experience or perceive in extending WASH services; and (c) approaches and next steps to improving WASH services. Participants engaged in these discussions using Google Jamboard, allowing everyone to participate by adding notes to a virtual whiteboard. Participants then re-convened in one virtual room to report the main points of each break-out discussion to the larger group. Written participant responses from each break-out room were compiled and analyzed for word frequencies using the Quantitative Discourse Analysis Package (qdap) in RStudio. Notes from each break-out room were reviewed and synthesized into major themes. In the following sections, we present an overview of emerging needs for WASH in high-income countries based on this synthesis with respect to knowledge gaps and current challenges identified by the session participants.

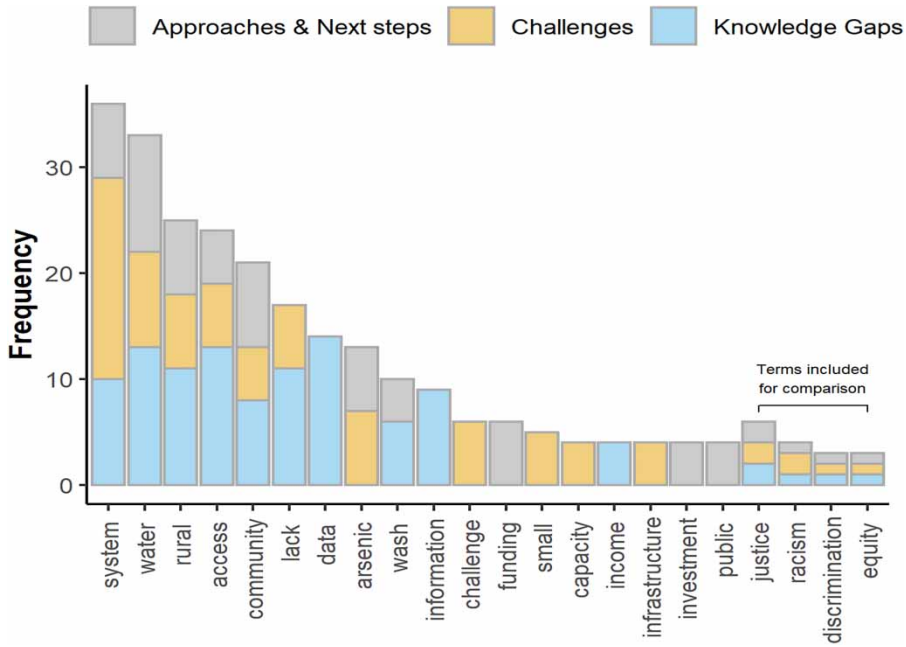

Figure 1 | Frequency graph of the top ten most frequent words in written responses to each discussion prompt during break-out session. Eleven terms are included for responses to 'Challenges' due to a tie between two terms. The last four terms ('justice', 'racism', 'discrimination', and 'equity') were not in the top ten most frequent terms of any single discussion prompt but were brought up frequently across multiple prompts and are included for comparison. Please refer to the online version of this paper to see this figure in colour: http://dx.doi.10.2166/washdev.2021.057.

RESULTS

Knowledge gaps

Despite the large amount of information and data available in high-income countries, significant WASH-related knowledge gaps exist. For example, elected officials, water and wastewater professionals, and the general public in high-income countries are often not aware of the communities that lack WASH access, which limits the appropriate allocation of resources to make improvements. 'Data' and 'information' were frequently mentioned terms during the break-out sessions (Figure 1). Some jurisdictions explicitly prohibit collection of data on ethnicity to decrease stigmatization of and discrimination against marginalized communities. However, these policies may also make it challenging to identify and provide assistance to underserved minorities (Anthonj *et al.* 2020).

Global reporting of WASH coverage may not fully reflect the reality in wealthy countries. Unlike low-income countries, where data are collected regularly through donor-supported national household surveys, high-income countries rely on censuses and other forms of data collection performed by national statistics offices and ministries. Unless specifically designed not to do so, these can under-represent some populations, such as people experiencing homelessness (Capone *et al.* 2020), the itinerant, or small pockets of unserved people. For example, a major issue specific to the U.S. was the decision to remove basic WASH questions from the U.S. census after 1990, making it difficult to assess changes in access over time and identify underserved populations (Dig Deep & US Water Alliance 2019). In the U.S., there are no current, comprehensive data on where residents get their water and how they dispose of their waste at the household scale (Gibson & Pieper 2017). Utilities are typically unwilling to share household-scale data on their service connections due to security and privacy concerns (Leker & Gibson 2018). Thus, JMP records are updated by governments of wealthy countries who provide what is called 'administrative data' rather than by direct analysis of household surveys. Although high-income countries have competent national statistics offices, it is not always clear whether they have properly documented and reported on minority and vulnerable populations. Small numbers of unserved people are easily lost in national averages. There is an urgent need for more granular and disaggregated data on WASH access by region and by socioeconomic indicators (such as income and race) in order to fill these gaps in data. Without fully documenting and understanding these differences, regional and local initiatives are unable to effectively improve WASH access in their jurisdictions.

Further, rural and urban areas have distinct differences both in access to WASH services and barriers to service delivery. For rural WASH, significant knowledge gaps exist around the quality of private well water (Hunter *et al.* 2021), the effectiveness of point-of-use treatment solutions for well users (Mulhern & MacDonald Gibson 2020), and the locations, maintenance, and impacts of septic systems (Withers *et al.* 2012). There is also lack of information on funding resources for small and/or rural communities since most funding favors large, urban, municipal systems. Meanwhile, WASH professionals working in both rural and urban contexts report either a lack of data and a lack of reporting on chemical constituents such as arsenic, industrial contaminants, and lead and other corrosion byproducts which can result in toxic exposures. These data gaps contribute to vast uncertainty in the magnitude of WASH inequities in high-income countries and the costs of eliminating them.

With such high access figures reported by the JMP (over 90% coverage of WASH), governments, citizens, non-profits, and service providers may assume that high-income countries do not need to learn from and share with other WASH professionals in low- and middle-income countries (LMICs). Among affluent populations, perceptions that WASH is only an issue in low-income countries hinders widespread public support and champions for reaching those left behind. In order to achieve universal coverage of WASH services, these gaps must be addressed.

Challenges of current practice

In addition to these knowledge gaps, a diverse range of challenges were identified that prevent WASH professionals from achieving SDG 6 in high-income countries (Figure 2), many of which mirror the challenges faced by WASH professionals in LMICs. These include lack of local capacity, inadequate funding, justice and discrimination issues, cultural obstacles, and specific technical challenges.

Capacity challenges include a lack of experience and training for operation, maintenance, and monitoring among existing system managers, as well as an overall insufficient workforce dedicated to operating water and wastewater infrastructure in isolated communities. Building and maintaining capacity is especially difficult in rural and Indigenous communities, such as American Indian reservations or remote Alaska Native villages. Increased training and career development opportunities among rural and Indigenous communities that honor and build on existing local capacities and strengths are needed. A

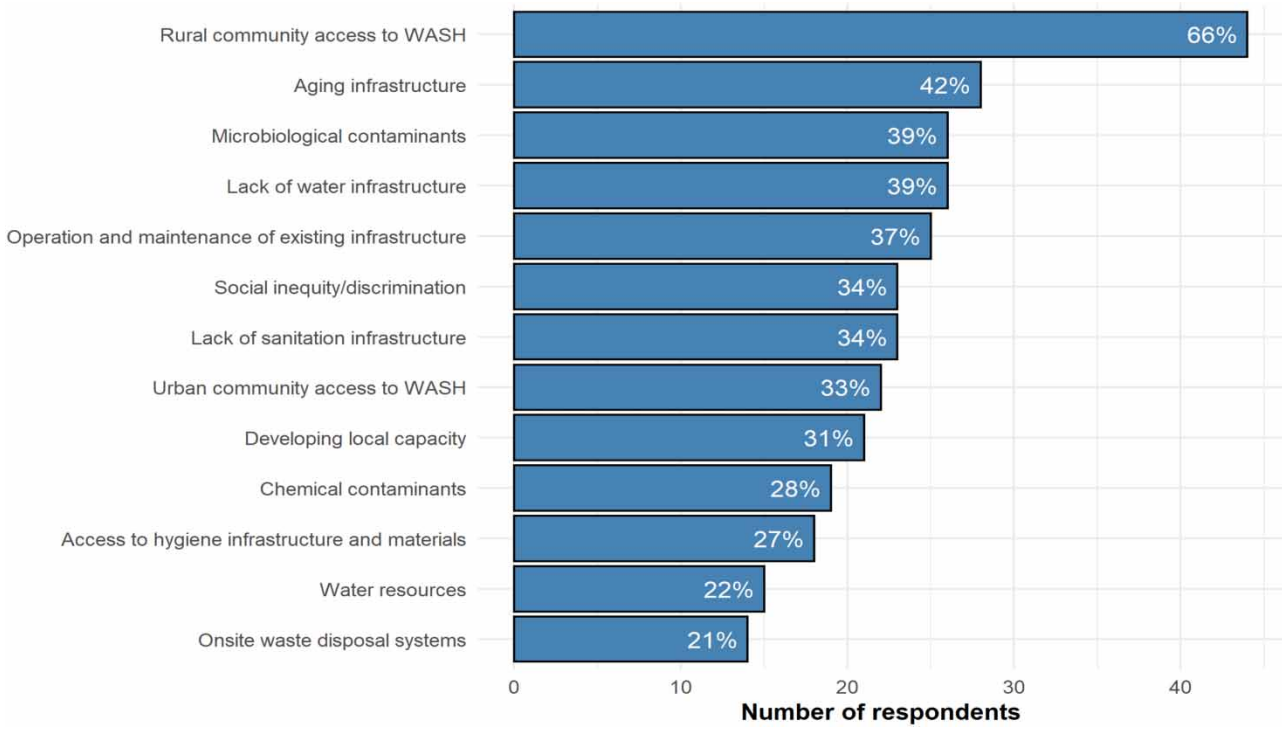

Figure 2 | Participant responses to a multiple-choice poll asking, 'What challenges do you engage with related to WASH in high-income countries?' at a UNC Water and Health Conference side session on achieving SDG 6 in high-income countries. Percentages are out of total respondents ($n = 67$), representing approximately half of the session participants.

further deficiency noted in the current workforce around water and wastewater in the U.S. was the lack of coordination between health care systems, water/wastewater utilities, and WASH professionals, and lack of coordination between various environmental, health, and social service agencies.

Funding constraints include the prohibitive costs of advanced water treatment for small systems that do not benefit from economies of scale, lack of federal funding for operation and maintenance costs, and fees for users to connect to and maintain municipal services. New funding structures that can help incentivize a skilled workforce among rural and decentralized systems are necessary. Additionally, the lack of funding for small systems to improve climate change resilience is an emerging concern for maintaining WASH services for those who currently have access.

Environmental injustice and racial discrimination are also major challenges to current practice. The terms '(in)justice', 'racism', 'discrimination', and 'equity' consistently emerged as cross-cutting responses to discussion prompts (Figure 1). One in three participants also reported that they deal with social inequity and discrimination issues in their work (Figure 2). Indeed, in the U.S. and Canada, racial minorities experience disproportionate toxic environmental exposures through their drinking water (Gochfeld & Burger 2011). Chronic chemical exposures related to lead pipes (e.g., Flint, Michigan) and industrial contaminants (e.g., 'Cancer Alley' in Louisiana) are an environmental justice concern for rural and urban, public and private drinking water systems. Historical colonial practices toward Indigenous communities in the U.S. and Canada have also largely dispossessed these groups of authentic ownership and decision making around water, sanitation, hygiene, and health. These injustices have prevented historically marginalized groups from being included in conversations or placed in positions of power within high-income countries. Sociocultural obstacles – including social stigmas around lack of hygienic living environments and disease, mistrust of government among underserved populations, and lack of legal documentation to receive some services – further inhibit participation.

Increasing water rates in urban areas is cited as a necessity for infrastructure improvement in the United States (Walton 2019), but was described by participants as challenging for urban water districts where the majority of rate payers are considered disadvantaged populations faced with environmental justice contamination issues. Most urban water utilities have significant price escalation (US Department of Energy 2017), and many are stretched thin when prioritizing infrastructure for improved water safety. However participants mentioned new 'human right to water' rules in some western states prevent disconnection and rate increases in areas with economic instability. These issues illustrate the ongoing challenge to eliminate the systemic barriers to equitable WASH solutions in high-income countries.

Finally, key technical challenges still exist among small, decentralized, and aging systems in both rural and urban areas. These include small-diameter pipes that cannot support fire flows, poor construction, challenging soil types, septic system failure in cold climates, overburdened septic systems leading to 'straight-piping' of waste directly into the environment, and overbuilt systems that no longer support the population size they were designed to serve. Results of these technical challenges include elevated water age, deteriorating chemical and microbial water quality, maintenance challenges, and increased costs. Drinking water treatment challenges related to arsenic in rural areas also were mentioned frequently by workshop participants (Figure 1), representing another shared WASH challenge between high-income countries and LMICs.

DISCUSSION: APPROACHES AND NEXT STEPS

To fill the knowledge gaps and address the challenges identified above, we recommend three broad priorities for WASH professionals, governments, water and wastewater utilities, and other stakeholders in high-income countries: (1) restructure national, regional, state, and local law and policy focused on drinking water and sanitation; (2) involve marginalized communities in decision-making processes; and (3) launch targeted data collection campaigns.

First, massive socio-political changes are needed to eliminate discriminatory practices, improve equity of resources and reduce social injustices in historically marginalized communities in high-income countries. Racist, nationalist, and colonial policies must be terminated and replaced with equitable legislation and regulations to protect and improve access for historically marginalized communities. Promising action steps include formally recognizing the human right to water (e.g., following the example of California's Human Right to Water Bill in the U.S.) and access to sanitation and the European Union's adoption of the Revised Drinking Water Directive, which prioritizes water access among vulnerable and marginalized groups (in addition to its prior emphasis on water quality concerns) in response to the European 'Right 2Water' initiative (Publications Office of the European Union 2018; European Commission 2020). However, legal mechanisms requiring that these human rights to water and sanitation are universally assured are largely non-existent. For example, over 42 million private well users

in the U.S. and 5 million in Canada are not protected under federal drinking water quality guidelines leaving the responsibility for ensuring safe drinking water entirely up to individual homeowners (Lee & Murphy 2020). Similarly, Member States in the European Union may exempt private water supplies from the minimum requirements of the Drinking Water Directive (World Health Organization 2011). Legislation is needed to improve access to funding for small and private water systems (e.g., the proposed 'Water Justice Act' [S.2466] introduced to the U.S. Senate in 2019), and extend public water and sewer lines to unserved areas.

In addition, historical and modern treaties and agreements with Indigenous peoples should be acknowledged and fulfilled, as called for in Canada and New Zealand (Borrows 2016; Klasing 2016). The water and wastewater sectors should continue to implement 'smart', resilient, and sustainable infrastructure standards, and governments should identify financing options to relieve the burden on low-income users and prioritize the allocation of resources toward communities and households without any existing services. In water-scarce or drought-prone areas, water conservation, stormwater management, and water reuse should be enhanced to help enable the extension of existing drinking water infrastructure to marginalized communities. Similar efforts to prioritize water and sanitation access, create equitable funding and legislative structures, and acknowledge governmental failures must be continued and replicated in high-income countries around the world.

Second, marginalized communities must be involved in decision-making processes to end discrimination and exclusion from access to WASH services. This includes increasing representation of marginalized people – including those from informal or undocumented communities – in spaces where policy, financing, and infrastructure are discussed, as well as creating new spaces for these conversations. The larger issue of improving the status and rights of undocumented persons will likely need to be addressed in tandem, so that members of these communities can feel safe participating. Community participants should be compensated for their time, child care should be provided, and meetings should be at times and in places and languages accessible to marginalized groups. Governments, working with stakeholders from civil society and industry, must increase investment in people and communities without access to WASH services, and special effort must be taken to identify solutions that can provide safe water and safely managed sanitation for itinerant populations and people experiencing homelessness. By encouraging better governance, capacity building, knowledge sharing, economic growth, and cultural revitalization, opportunities will arise for new, community-based leadership to holistically address WASH access and other development challenges.

Finally, high-income countries need to prioritize data collection to fill knowledge gaps around WASH access. 'Left behind' communities cannot be expected to wait for the long-term social change described above before obtaining access to water, sanitation, and hygiene services and the critical health, livelihood, and dignity improvements that come with them. Thus, the WASH sector simultaneously needs to inventory aging infrastructure, increase efforts to identify and map water quality standard violations, and determine capacity to pay among underserved groups. These efforts should be led by high-income country governments to create best practices for such data collection efforts in specific settings. National efforts must also include appropriate coordination to share data among agencies, tribes, countries and with international organizations. Knowledge exchanges should also be initiated with WASH programs and professionals between high-income countries and communities and with LMICs to share successful approaches. As WASH initiatives in LMICs have demonstrated, research to develop improved services or to evaluate outcomes should be transdisciplinary, intersectional, qualitative and quantitative. Similarly, WASH practitioners should employ holistic approaches and systems thinking to ensure that WASH improvements can be empowering, leverage other societal developments and form the basis for continued improvements in health and wellbeing.

CONCLUSIONS

This practical paper synthesizes major knowledge gaps, challenges and next steps to achieve SDG 6 – water and sanitation for all – in high-income countries, as identified by more than 100 WASH professionals in a session at the 2020 UNC Water and Health Conference. Despite assumptions to the contrary, high-income countries still face deficiencies in available data and providing critical WASH services and infrastructure to millions of people. The lack of WASH access has not been prioritized in local and national politics in high-income countries, and many communities lacking access in high-income contexts are informal, undocumented, and invisible to country-wide metrics. Furthermore, the WASH landscape in high-income countries has some distinctions from LMICs, with a greater focus on water quality and chemical exposures, including concerns around deteriorating infrastructure and contamination from industry. Widespread support for WASH delivery in these contexts is limited by the lack of public awareness and further challenged by a lack of local capacity, inadequate funding, social and

environmental injustices, discrimination, and specific technical/engineering problems. To meet these challenges, the traditional water and wastewater sectors in high-income countries and global WASH professionals must work together to remove unjust social structures, advocate for targeted legislation around the human right to water and sanitation, and involve community members in research, data collection, and policy to close these gaps and finally reach those left behind.

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AUTHOR CONTRIBUTIONS

The first three authors (Mattos, Mulhern, Naughton) contributed equally to the writing of the original draft of the manuscript and are listed alphabetically by last name. The subsequent authors are listed alphabetically by last name thereafter and contributed to developing and leading the conference session and to revising and editing the final manuscript.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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