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RESEARCH ARTICLE

Stakeholder Perspectives on Data-Driven Solutions to Address Cardiovascular Disease and Health Equity in New York City



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Introduction: There is growing recognition of the importance of addressing the social determinants of health in efforts to improve health equity. In dense urban environments such as New York City, disparities in chronic health conditions (e.g., cardiovascular disease) closely mimic inequities in social factors such as income, education, and housing. Although there is a wealth of data on these social factors in New York City, little is known about how to rapidly use available data sources to address health disparities.

Methods: Semistructured interviews were conducted with key stakeholders (N=11) from across the public health landscape in New York City (health departments, healthcare delivery systems, and community-based organizations) to assess perspectives on how social determinants of health data can be used to address cardiovascular disease and health equity, what data-driven tools would be useful, and challenges to using these data sources and developing tools. A matrix analysis approach was used to analyze the interview data.

Results: Stakeholders were optimistic about using social determinants of health data to address health equity by delivering holistic care, connecting people with additional resources, and increasing investments in under-resourced communities. However, interviewees noted challenges related to the quality and timeliness of social determinants of health data, interoperability between data systems, and lack of consistent metrics related to cardiovascular disease and health equity.

Conclusions: Future research on this topic should focus on mitigating the barriers to using social determinants of health data, which includes incorporating social determinants of health data from other sectors. There is also a need to assess how data-driven solutions can be implemented within and across communities and organizations.

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INTRODUCTION

New York City (NYC) ranks among the wealthiest cities in the world; yet, income inequality and health disparities remain significant problems across NYC neighborhoods, with life expectancy ranging from 75.1 years in Brownsville, Brooklyn to 85.9 years on the Upper East Side of Manhattan.¹ In part, this is due to differential

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distributions of the social determinants of health (SDOH), or the nonmedical factors that influence health outcomes, such as income, housing quality, transportation access, and education, between NYC neighborhoods^{2,3}; for example, the median household income in Brownsville was \$32,940 in 2019, compared with \$141,090 in the Upper East Side.⁴ These disparities in SDOH also drive inequities with regard to the distribution of chronic health conditions such as cardiovascular disease (CVD), the primary cause of death for NYC residents, with deaths due to CVD totaling 17,821 deaths in 2019.⁵ Yet, the premature death rate due to CVD is twice as high in high-poverty areas (66.8 deaths per 100,000 persons) as in low-poverty areas (27.9 deaths per 100,000 persons),⁶ and neighborhoods with low educational attainment have higher rates of adverse clinical outcomes due to CVD.⁷

There is widespread recognition of the importance of addressing SDOH to improve health equity in chronic disease outcomes⁸ as well as a wealth of SDOH data at the state and local levels.^{9–12} Within the healthcare delivery system, addressing SDOH has entailed collecting more data on patients' SDOH-related needs, for example, through the use of SDOH-specific screening tools¹³ or with diagnostic Z codes corresponding to SDOH, which can be reported in an electronic health record (EHR) system during a clinical visit.¹⁴

There is a growing availability of SDOH data,¹⁵ and in recent years, there have been greater efforts to meaningfully use SDOH data to address health equity. For example, in 2019, the Agency for Healthcare Research and Quality launched a challenge to develop tools for communities to use the data available to them in meaningful ways.¹⁶ Such tools include visualizations to help policymakers and other stakeholders understand how SDOH are associated with health outcomes, applications that connect individuals with SDOH needs to resources in their communities, and programs that help plan and deploy resources to high-risk individuals in the face of a climate event.¹⁵ Similarly, in 2021, the Robert Wood Johnson Foundation created an initiative to use SDOH data to illuminate drivers of health inequities.¹⁷ Other tools include efforts to integrate standardized SDOH screening tools, such as the Centers for Medicare & Medicaid Services Accountable Health Communities Screening Tool, into EHR systems.¹⁸ However, less is known regarding which data-driven strategies would be most useful to health system leaders and public health decision makers trying to reduce health disparities in their communities.

This paper explores the perspectives of multiple stakeholders regarding SDOH, data, and CVD in

NYC. Given that SDOH are context specific, decision makers within the same environment may have different perspectives on how SDOH are conceptualized within their community. As such, we used data from interviews with different stakeholders in NYC to assess priorities related to SDOH and how SDOH data can be used to address these priorities, what data-driven tools would be most useful to address health equity, and intersectoral challenges to using and developing such tools. In doing so, we identify gaps in current practice with salience to health leaders engaged in innovative initiatives to improve community health as well as potential interventions to overcome challenges in using SDOH data to address health needs.

METHODS

Study Sample

We conducted qualitative, semistructured interviews with key stakeholders across the public health and healthcare landscapes in NYC. Interviews were conducted as part of the AI4HealthyCities Health Equity Network project created by the Novartis Foundation. [Appendix Table 1](#) (available online) includes the interview guide.

Interviews were conducted with leaders from public health organizations, healthcare systems, and community-based organizations (CBOs) pertaining to their priorities, perspectives, and activities related to health equity, SDOH, and CVD. [Appendix Table 2](#) (available online) describes the interviewee's roles and sectors. We focused on CVD because it is the main cause of death of NYC residents and because its determinants are multifactorial.⁵

From June to July 2022, representatives from selected key stakeholder organizations were recruited into this study. Key stakeholder organizations were selected on the basis of their involvement in implementation of public health programs, health services delivery, addressing SDOH, and working with EHR or SDOH data. The research team aimed for maximum variation sampling to recruit a diversity of healthcare professionals representing various job roles and organizations. Fourteen potential interviewees were invited to participate through e-mail, 11 of whom agreed to participate and were included in our study. Interviews were 30–60 minutes in length and conducted over Zoom. At least 2 team members attended each interview, which was recorded after obtaining consent from interview participants. We used automatic transcription through Zoom to create interview transcripts. This study received ethical approval from the IRB at New York University.

Measures and Analysis

Team members reviewed each transcript along with the audio recording for quality-editing purposes. The team then analyzed the qualitative data collected from the interviews using a matrix analysis approach to rapid coding,¹⁹ which entails creating a matrix of qualitative findings (usually paraphrased or directly quoted) to establish relationships between categories of data and note differences, trends, and similarities between responses.¹⁷ In our study, each of our initial interview questions was assigned a predetermined domain name on the matrix template, and the research team used the templates to organize responses on the basis of interview question category along with illustrative quotes. For the purposes of this paper, the research team focused on 4 interview question categories: the most salient SDOHs to cardiovascular health, current data/nodata solutions, future solutions to address SDOH and health equity, and barriers to implementing data-driven tools to address SDOH. The research team ($n=7$) initially tested the matrix template using 2 interview transcripts and performed side-by-side comparisons of the information extracted and made minor adjustments to the matrix template to ensure ease of use and enhance intercoder reliability. Three team members then split up the remaining templates and coded the matrix template. As a final step, the team reviewed coding notes across regular meetings to resolve discrepancies across coders and synthesize and further categorize findings on the basis of the patterns and relationships found between matrix categories.

RESULTS

Interview responses were grouped into 4 main categories related to data-driven tools to address SDOH: (1) priorities related to SDOH, (2) current uses of data, (3) potential future uses of data, and (4) carriers and challenges to using data. A summary of findings along with descriptive quotations from interviews can be found in [Table 1](#).

Priorities Related to Social Determinants of Health

Each participant stressed the importance of health equity and addressing SDOH in their work and listed a number of SDOH that were priorities for their organizations, many of which were overlapping between participants. These included housing, dietary and water intake, grocery purchases and food insecurity, the digital divide or the gap between populations in terms of technologic literacy and access, access to and utilization of health services, family communication, and low physical activity or mobility patterns due to residing in high-crime

neighborhoods. Participants described these SDOH as the root causes of health inequity in NYC and discussed their prioritization of low-resourced communities in efforts to address CVD and SDOH. In particular, participants noted the importance of recognizing how the history of disinvestment and redlining in NYC affected the health outcomes of communities.

Current Uses of Data

Participants described a number of data-driven tools to address SDOH within their organizations, which fell into 3 categories of general purpose: (1) identify disparities in care, (2) provide tailored services and resources to patients, and (3) monitoring and evaluation purposes. Although respondents were asked directly about equity related to CVD, they spoke about health equity generally. SDOH data used within these tools included SDOH data collected directly from patients, either through the use of ICD-10 diagnostic codes for SDOH (Z codes); organization-specific screening tools that stratified data by sex, race, and ethnicity; as well as locally collected data such as the NYC Community Health Survey. Participants also discussed the potential to obtain SDOH data through entitlement programs that patients are eligible for, which may also be visible on the EHR. Similarly, health outcome or utilization data used in such tools were obtained through the EHR.

Identify Disparities in Care

Participants highlighted the use of data-driven tools to identify disparities in access to care, care outcomes, or experiences in care. Specifically, these included efforts to identify and reach out to patients who appear nonadherent to medications; to assess the root causes and intervention points for patients with multiple hospitalizations using data obtained from social service agencies such as housing-assistance organizations; to track whether participation in programs, such as housing vouchers, affected utilization of care; and to assess disparities in populations that are or are not accessing care.

Provide Tailored Services and Resources

Other participants discussed tools that used data to provide tailored services and resources to patients with SDOH needs. These included peer programs to facilitate social and disease-management support, meal programs that deliver medically tailored meals to patients with specific chronic conditions, tools that flag patients with specific SDOH needs and refer them to community health workers or social service agencies (i.e., housing assistance programs), and tools that identify public assistance programs (i.e., Supplemental Nutrition Assistance

Table 1. Summary of Findings and Descriptive Quotations From Stakeholder Interviews Regarding Data-Driven Tools to Address SDOH

Domain	Summary of findings	Quotes
Priorities related to SDOH	SDOH considered important to address: housing, dietary intake/food insecurity, digital divide, access/utilization of health services, and low physical activity Disinvested communities	<p>“Over the years, it was always lower income communities and access to healthy food and more access to opportunities for physical activity, but now, what we’re hearing is everything is kind of worse—so it’s not just access to healthy food, it’s access to food, which is resulting in a lot more food insecurity.”</p> <p>“There’s no health without housing. One of our greatest challenges is that once individuals accept housing and transition to housing, making sure that their connections to that medical care or treatment care, whether its medical or psychiatric, remains intact. Oftentimes, once an individual is housed, you know they don’t want to go outside to medical care”</p> <p>“The communities that were redlined in the thirties are still the communities that have the worst health outcomes. . . . And so we can say that those communities, because they were disinvested in terms of like literally absolutely disinvested from the banks, that they also suffer from the other things that you would need in terms of sort of cardiovascular health. . . . it’s walkability, it’s fresh food supplies, it’s good education, it’s daycare.”</p>
Current uses of data	Data used to identify disparities in care Data used to provide tailored services and resources to patients Data used for organizational purposes	<p>“In the last year or so we actually started reporting on our quality measures based on race and ethnicity and also reporting complaints and taking into consideration race and ethnicity... Now we’re actually segmenting this based on gender, race and ethnicity, to see well are we seeing some correlation between the gaps in care or complaints, or dissatisfaction based on race and gender.”</p> <p>“So what we’ve done for diabetes is to match a well-controlled diabetic to an uncontrolled diabetic, and we did this through a vendor. But not just match, not just like a peer program because those exist quite a bit, but really match them on a deeper level, their cultural background, ethnicity, you know we did lots of matching, not just diabetic to diabetic.”</p> <p>“The data that we’ve been looking at so far is that we see more men are coming to their cardiology visits than women. We were like, why is that happening? Usually the women are the caretakers. But for some reason our cardiology clinic we couldn’t figure out what was the issue, were they not feeling comfortable?”</p>
Potential future uses of data	Transfer and aggregation of data Use data to mobilize resources	<p>“In an ideal world, we would be able to streamline referrals to CBOs [community-based organizations] and CBOs would be able to get those referrals, and do outreach to the patients. When they see the patient, they would be able to send us back information as to whether the patient was seen. This is what would happen. That’s in an ideal world, we’re definitely not there yet.”</p> <p>“Patients are getting better about using home blood pressure readings, or collecting data from pharmacies, or from the community fairs where people get their blood pressure checked every now and then. Actually having all of that sort of pour into some central repository [would be useful]. That’s one thing that I think about. Like at a dentist visit, sometimes you get your blood pressure measured, right?”</p> <p>“And wouldn’t that data be amazing for me if that blood pressure machine or that fitbit or whatever translated into epic (EHR system)? Right because as soon as they come to their visit I can say I see you did not exercise, I see a graph here in the you know, last two weeks, you didn’t move 10 minutes your heart rate never went up to this certain level.”</p> <p>“If there’s like a minimum data set tool or card that everyone can carry, so that where they’re meeting a social service provider or community based provider, they can just scan it.”</p> <p>“I think it would make sense for us to understand, specifically where the high need is. The South Bronx is a large area, and at some point we had a thought of really identifying very specific zip codes and actually creating a physical hub that we will occupy, and have a space for the Community to come.”</p>
Barriers and challenges to using data	Barriers related to the quality, content, and collection of SDOH data Barriers related to data sharing Barriers translating data insights into practice	<p>“The barrier would be that we don’t have data for all the population, for example, commercial health, we don’t have patient demographics, we don’t know who they are, where they are, where they live. The system is still being built, but has not been implemented yet so in the meantime we do not have very good data sources to identify the potential social determinants of health related to the outcomes.”</p> <p>“The biggest issue we run into is that the way we characterize race /ethnicity in our medical record was sometimes made by someone other than the patient. So they’re really uneven. So when someone registered, if they didn’t check the box saying like, ‘I self-identify as white, non-Hispanic,’ whoever was registering in the system would eyeball them and decide for them.”</p> <p>“If something is not regularly required to be reported, you often have the flash, what is called, ‘the streetlamp problem.’ You’re only illuminating the parts that you can see. And so only certain people will be depositing data into that. So, there are some biases that are ingrained by virtue of that.”</p> <p>“Every hospital system has a different EHR; You have somebody using EPIC, you have others that are using Bursa. So it would be nice if there was a collective way of getting the information from all partners, whether it’s a hospital, whether it’s a community organization, whether it’s a smaller entity or even a health home.”</p> <p>“There’s a lot of roadblocks. So, we can’t refer a patient directly to a CBO without some consent from the patient. And that’s fine. But the CBO also cannot give us information.”</p>

CBO, community-based organization; EHR, electronic health record; SDOH, social determinant of health.

Program, Medicaid) for which patients may be eligible on the basis of their needs.

Monitoring and Evaluation Purposes

Data were also used by organizations at the facility level for monitoring and evaluation purposes. One organization stratified patient-reported quality measures by patient sex, race, and ethnicity to assess whether correlations exist between gaps in care, complaints, or dissatisfaction with care based on patient demographics. Two organizations described using data to plan for service delivery and care processes after coronavirus disease 2019 (COVID-19), for example, to determine which additional services, such as food assistance programs, should continue to be offered as well as to assess how to best serve their patient population more generally. Population health data, which includes data on patients' SDOH, were also used to obtain awards and certifications, which were then used to obtain higher reimbursement rates from insurers, and to assess whether care improved after medical-home certification. Finally, 1 participant described an initiative from New York State that aimed to connect all patient EHR systems statewide to enable improved health information exchange across healthcare organizations.

Potential Future Uses of Data

Participants discussed potential future uses of data that fell into 2 overall categories of use: (1) transfer and aggregation of data between different organizations and (2) use of data to mobilize resources. However, underlying these future solutions was a widely acknowledged need for access to a more comprehensive range of SDOH data. This included data on SDOH obtained from qualitative interviews with patients, longitudinal SDOH data on patients going back 10 years, as well as different categories of SDOH data beyond the health system.

Transfer and Aggregation of Data

Participants cited the need for systems that combine data from different EHR systems, providers, and CBOs to enable better follow-up with patients after appointments (i.e., did patients pick up medication or attend a nutrition visit?) and to close the loop on patient referrals. Participants also commented that it would be useful to have real-time data on patient SDOH or risk factors, which could be tracked through wearable technologies, such as FitBits, and that would ideally feed back into an EHR system. In addition, participants discussed the need for tools or dashboards upon which patients can collect their own SDOH data and which they can then transfer or share with different providers or CBOs.

Use Data to Mobilize Resources

To help organizations obtain additional funding or resources from decision makers, participants noted that it would be useful to have technologies that use data to model the returns on investments to address SDOH. In addition, participants discussed the need for tools that detect patients with undiagnosed chronic diseases to ensure the appropriate delivery of services to these populations. Similarly, participants envisioned using data to more directly pinpoint areas of high need to enable targeted allocation of resources into communities.

Barriers to Adoption or Implementation of Data-Driven Tools Using Data Collected Within Existing Electronic Health Record/Health Data Systems

Barriers to implementing data-driven tools within health data systems fell into 3 categories: (1) barriers related to the quality, content, and collection of SDOH data; (2) barriers due to data sharing; and (3) barriers to translating data insights into practice.

Barriers Related to the Quality, Content, and Collection of Social Determinants of Health Data. Barriers within this category included a lack of adequate data on SDOH, with screening questions pertaining to race, ethnicity, or housing status often left blank; unstandardized data collection (e.g., race categories may be measured in different ways across systems or may fail to capture all racial/ethnic identities); or data that are outdated by multiple years. In part, the lack of up-to-date, accurate data on SDOH stems from the fact that most systems rely on patient self-reporting of SDOH needs or must reach out individually to patients to obtain this information, a laborious, time-consuming task that is often unfeasible. In addition, such manual entry of SDOH information is error prone, making misidentification a concern. Participants also described situations in which patients' SDOH characteristics are characterized by clinical staff, which may further introduce errors in the data. Interviewees also noted that much of patient SDOH data may be contained within provider free-text notes on an EHR, which is difficult to extract and analyze. Finally, participants discussed biases in irregularly collected health and SDOH data, noting that the information gathered may fail to encompass other aspects of an individual's life or identity.

Barriers Related to Data Sharing. A significant challenge cited by participants was interoperability between EHR systems as well as challenges pertaining to data and information sharing between organizations. Information on patients' SDOH needs may be collected within EHR systems; however, different hospital systems or provider networks often have different EHR systems, making it difficult to exchange data across the healthcare system.

Furthermore, confidentiality laws pertaining to protected health information prevent data sharing between the healthcare system and community organizations, making it difficult to forge partnerships or facilitate referrals between the clinical and nonclinical sectors.

Barriers to Translating Data Insights Into Practice

Participants discussed challenges surrounding the use of SDOH data in practice as well as in translating results obtained from data-driven tools into meaningful insights. In part, such barriers were driven by imprecise algorithms (i.e., algorithms that capture significantly more or only part of the SDOH data an organization is interested in) as well as providers who are inexperienced with data or unwilling to incorporate data (such as a patient portal displaying SDOH information) into their clinical routine. Participants also noted that although healthcare systems have metrics related to patient safety, there is a lack of metrics related to SDOH, making it challenging for healthcare systems to measure and assess their efforts at addressing SDOH and health disparities overall. Similarly, participants discussed how most payment models do not incentivize or reward addressing SDOH, which limits stakeholders' abilities to address these issues, even when data on patient SDOH are available.

DISCUSSION

Interviews with key public health stakeholders and policymakers revealed the importance of SDOH data across the public health landscape in NYC. Respondents were optimistic that data-driven tools can be used to aggregate data between different sectors, connect patients with resources, and advocate for resource allocation to high-needs communities. However, respondents described challenges and concerns with the current use of SDOH data, including the error-prone nature of manual SDOH data collection, bias related to how some data such as race are collected, and interoperability between organizations' data systems.

Interviewees noted priorities within their organizations related to SDOH such as housing, nutrition, physical activity, and technologic literacy but described their current data use as being centered on EHR/health system-based data. As such, discussions of future uses of data focused on population-level data stemming from other sectors, external to the health system. Similarly, potentially useful tools were those that could enable the transfer of data between different organizations and allow patients to own and transport their SDOH data between organizations as well as those that could aggregate data from a wider variety of sources, such as wearable technologies. Recent efforts to coalesce data that

encompass a wide range of SDOH markers have been at the community level and include the Agency for Healthcare Research and Quality's SDOH database,²⁰ which links together SDOH data that are available nationwide at ZIP code and county levels, as well as the Factors Affecting Communities and Enabling Targeted Services database, which combines SDOH data available at the census-tract level in NYC.²¹ Using such additional, community-level data sets may help overcome many of the limitations of health system-collected data as well as add layers of information to help connect the dots between the community context and individual health outcomes.²² Similarly, tools that could enable patients to continuously update their SDOH data themselves and ensure their transfer across settings could allow a more precise understanding of the root causes of disparities in chronic disease health outcomes.

Previous studies have described the challenges of addressing SDOH and health equity; in part, this is because the causes of inequity are complex, interrelated, and with no immediate solution.^{23,24} Results from our analysis echo these findings because respondents described various challenges of working with EHR and health system-based data to address equity-related issues and had different perceptions of potential data-driven solutions. For example, although respondents agreed that higher-quality SDOH data are required to develop data-informed approaches to address health equity related to CVD in NYC, they also cited different barriers to obtaining such higher-quality data and had no clear consensus on strategies to overcome these challenges.

In recent years, policy efforts have focused on addressing many of the barriers related to SDOH data identified by participants, in particular interoperability between data/EHR systems, and the lack of standardization and low quality of SDOH data. At a federal level, the Center for Medicare and Medicaid Innovation requires all new Accountable Health Communities Model participants to collect and report on data related to health-related social needs and SDOH.²⁵ In addition, the Health Resources and Services Administration has allocated \$90 million to support the collection of patient-level SDOH data within the Uniform Data Systems of Federally Qualified Health Centers, where many low-income and low-resourced individuals receive care.²⁶ However, to truly enable comprehensive SDOH data collection, such measures and standards must be adopted throughout all health systems as well as expanded to health-adjacent sectors, such as housing, transportation, and food assistance agencies.

Limitations

This study has several limitations. First, these interviews reflect the views of leaders across the healthcare

landscape in NYC and may not reflect those of health-influencing sectors in other cities, states, or regions. Second, this study presents the opinion of health system/department of health/community organization executives and does not elaborate on the perspectives of direct healthcare service providers or the experiences of patients or individuals within the communities described in this study. Third, participants were identified on the basis of known knowledge and engagement with the subject of SDOH in NYC, and participation was voluntary; as such, participation may have been biased toward those who felt most strongly about the topic of SDOH or data-driven solutions. Fourth, our study has a small sample size of N=11 participants, which may have limited the range of stakeholder insights provided. Finally, our study combines the experiences of different sectors into 1 group. Although we described how perspectives on SDOH and data varied between participants, views of SDOH and data may also depend on the type of organization with which a respondent is affiliated. As such, our study fell short of thoroughly comparing the experiences and perspectives across sectors.

Despite these limitations, our study adds insight into how data-driven tools can be designed to address SDOH and health disparities. Having a diverse set of stakeholders informing these insights is important given that many tools in the public health and healthcare space are designed to be used by multiple stakeholders because solutions to health-related challenges require collaboration across multiple disciplines and professions.⁹ Health equity is a particularly complex issue, and efforts to address inequities within individual sectors, for example, in healthcare settings, have limited impact.²⁷ As such, there is a recognized need for conversations surrounding health inequities to link perspectives from across the public health and healthcare landscape²⁷ and that data-driven strategies should inform decisions related to improving health equity across sectors.²² Findings from our interviews confirm this because respondents noted the importance of combining data across both the healthcare and social service sectors in efforts to improve the health and well-being of populations.

CONCLUSIONS

Our analysis of stakeholder perspectives on using data to address SDOH is timely, given the impact of the COVID-19 pandemic on individuals with higher numbers of social needs^{28,29} and the stress that the pandemic has placed on the health system, both in NYC and throughout the U.S, with many health systems experiencing severe financial losses because of COVID-19.^{30,31}

There is recognition that social factors are essential to improving health outcomes, and health systems wishing to target high-risk patients in efforts to reduce costs, more effectively allocate constrained resources, and improve patients' outcomes must address SDOH risk factors. However, comprehensive data on patient SDOH as well as collaboration with external organizations that may be better equipped to address SDOH needs are required to help communities and individuals recover from the fallout of COVID-19 and target systemic drivers of inequity. Future research on this topic should focus on addressing and mitigating the barriers to using SDOH data within health systems, enhancing SDOH data literacy among patients and providers, as well on combining health systems data with data sets from other health-influencing sources to understand which SDOH are the main drivers of poor health outcomes. Given the challenges with individual-level SDOH data collected within health systems, neighborhood level-SDOH data should be prioritized to enable health inequities to be uncovered at a more granular level. It will also be essential to assess how the data-driven solutions identified by respondents can be implemented across organizations and determine a way to translate data-driven insights into policy and action.

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SUPPLEMENTARY MATERIALS

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