Developing Data Strategies for Future Emergencies

Memorandum Report 2023-4

March 21, 2023

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The COVID-19 pandemic sharply increased the need for emergency relief funds at the local level. This presented local governments with a tradeoff common to emergency situations: (1) whether to disperse relief funds as quickly as possible; or (2) whether to delay dispensing relief funds to ensure optimal compliance with grant criteria and to achieve outcomes as effectively and efficiently as possible. For the latter to succeed during the COVID-19 pandemic, many local government agencies would have needed to build the infrastructure and capacity required to collect, verify, analyze, and report data, which would have taken time to accomplish. Montgomery County and many other local governments made the conscious decision to prioritize expeditious distribution of funds in their primary relief programs.[1]

Due to the climate crisis, spread of infectious diseases from globalization, economic crises, and other risks beyond their control, local governments face a future that will likely require responses to more frequent and intense emergencies. How well local governments prepare for these future emergencies beforehand will largely determine their ability to mitigate harm to residents when they arrive.

With the peak of the COVID-19 pandemic behind us, the County Council has asked the Office of Legislative Oversight (OLO) to examine how County agencies could collect and track data related to emergency relief funds in a way that would not delay the flow of funds in future emergencies. In other words, how the County can reduce, if not eliminate, the tradeoff between the rapid disbursal of funds and program effectiveness and efficiency described above. To this end, this memorandum report identifies "promising practices" (i.e., policies and practices supported by the best available evidence) that County government can draw on to improve its tracking and reporting of data on relief program in future emergencies.

[1] See Aiken, Claudie, Vincent Reina, Julia Verbrugge, Andrew Aurand, Rebecca Yae, Ingrid Ellen, and Tyler Hauper, Learning From Emergency Rental Assistance Programs: Lessons From Fifteen Case Studies, NYU Furman Center, March 2021; Kneebone, Building Local Institutional Capacity; and Limarzi, Megan, COVID-19 Rental Assistance Programs, Office of the Inspector General, Montgomery County MD.

Major Findings

1. According to interviews with other jurisdictions and literature on promising practices, establishing a government wide data strategy during nonemergency times is key to responding quickly and accurately with a data-driven approach in emergency times.
2. Using data effectively during an emergency requires having developed a robust data infrastructure and data-driven culture during normal operations.
3. Expert guidance indicates that having a central recovery team for emergency response and recovery efforts are crucial.
4. When emergency relief funds are released, government agencies must balance the rapid release of funds while ensuring appropriate financial safeguards are in place.
5. County staff report that in general, departments work in an ad hoc manner, meaning each department creates, maintains, and publishes data differently in a generally nonscheduled way. This can lead to noninteroperable data silos.

Glossary

- **Centralized Data –** data that is stored, located, and maintained in a single location and can only be modified and managed from that single location
- **Data** – a series of measurements, observations, facts, or items of information that are collected and often stored and used by a computer.
- **Database** – an organized collection of structured information, or data, typically stored electronically in a computer system.
- **Data Infrastructure** – the hardware, software, networking, services, policies, training, and other components that enable data consumption and sharing.
- **Data Literacy** – the ability to speak, read, and write data, and to translate it into actionable information.
- **Data Maturity** – the readiness of data to be applied in decision-making, which includes quality and granularity of data collected as well as organizational processes and strategies for the usage of data.
- **Data Reporting** – the process of collecting, storing, and displaying data to monitor the performance of a process.
- **Data Silo** – a collection of data held by one group that is not easily or fully accessible by other groups in the same organization.

- **Data Tracking** – the process of identifying metrics to be tracked and collecting and analyzing data related to those metrics.
- **Data-Driven Culture** – an organizational culture in which decision making and practices are informed by insights generated from data when appropriate.
- **Decentralized Data –** data that does not have a central owner, meaning that data is spread across multiple servers and controlled and editable by multiple users
- **Evidence-Based Policy** – the systematic use of findings from program evaluations and impact analyses to guide government policy, funding, and programming decisions.
- **Evidence** – a body of facts and information showing whether a claim is true or false, includes both quantitative and qualitative data.
- **Quantitative Data** – numerical data often used in statistical analysis.
- **Qualitative Data** – data presented as descriptions of qualities, characteristics, or types.
- **Performance Measures -** the process of collecting, analyzing and/or reporting information regarding the performance of an individual, group, organization, system or component.

Methodology

Despite wide recognition of both the increased risk of emergencies and how data and evidence can be used to improve government performance, there are no definitive guidelines on how local governments should use data to improve emergency response. Indeed, while there are extensive literatures on evidenced-based policy and emergency management, limited attention has been given to the nexus between these topics. In this report, OLO bridges this gap by adopting a multi-method approach aimed at:

(a) Understanding how the County used data and evidence during the COVID-19 pandemic response; and

(b) Identifying promising practices to help the County government use data and evidence in future emergencies to improve the effectiveness and efficiency of its relief programs without sacrificing expeditiousness.

To understand how the County used data analytics during the pandemic, OLO conducted interviews with employees in CountyStat and reviewed OLO reports on the County's use of data and Office of the Inspector General (OIG) reports on the County's pandemic response.

OLO also interviewed personnel from local governments that effectively used data and evidence in their COVID-19 pandemic responses. To establish an unbiased list of potential candidate jurisdictions, OLO referred to the What Works Cities Certification, which is a standard to evaluate how well local

governments "are managed and whether they have the right people, practices, and policies in place to put data and evidence at the center of decision-making."[2] The certification process involves governments undergoing the What Works Cities Assessment to evaluate the strengths and weaknesses of their data and evidence practices in eight categories—data management, leadership and capacity, performance and analytics, results-driven contracting, rigorous evaluations, open data, data-driven budget and finance, and stakeholder impact.[3]

OLO then reviewed the websites of the current 55 certified cities to identify a subset of local governments that applied a data and evidence approach to their pandemic responses. Jurisdictions were selected if they went beyond tracking and reporting on health-related metrics (e.g., COVID-19 case and vaccination rates) and published publicly available dashboards or reports detailing the use of relief funds and/or performance of relief programs. OLO interviewed personnel primarily from data performance and management offices from nine jurisdictions to learn the following:

- How these jurisdictions tracked and reported data to the public;
- Whether and why they believe using a data and evidence approach to relief programs aided the government's emergency response;
- What challenges they encountered; and
- What lessons they have drawn from their experiences.

In addition to interviewing personnel from local governments that effectively used data and evidence in their pandemic responses, OLO identified promising practices by reviewing selected materials on emergency financial management by the Federal Emergency Management Agency (FEMA) and literature on data-driven and evidence-based policy and practice. In particular, OLO reviewed case studies on the use of data to improve governance and analyses from organizations focused on helping governments use data and evidence to improve policy and practice.

[2] Results 4 America, About What Works Cities Certification; Bloomberg, About What Works Cities.
[3] Results 4 America, What Works Cities Assessment.

Scope of Memorandum

This memorandum report focuses on identifying promising practices in data processes such as tracking and reporting during nonemergency times. The report is organized as follows:

- **Section I** presents an overview of data tracking and usage in local government and how it relates to disbursement of emergency funding;
- **Section II** identified nine jurisdictions with records of strong data processes and use and summarizes feedback OLO received from interviewing employees in those jurisdictions on their collection and use of data during the COVID-19 pandemic;
- **Section III** reviews promising practices in data collection, tracking, and analysis during nonemergency times;
- **Section IV** describes the County's response to the COVID-19 pandemic and current County data use; and
- **Section V** presents OLO's findings and discussion items.

Acknowledgements

Office of Legislative Oversight (OLO) staff members Stephen Roblin and Kaitlyn Simmons conducted this study, with assistance from Karen Pecoraro and Leslie Rubin. OLO received a great level of cooperation from everyone involved in this study. OLO appreciates the information shared and the insights provided by all who participated. In particular, OLO thanks:

County

Fariba Kassiri, ACAO

Michael Baskin, CEX

Earl Stoddard, CEX

David Crow, FIN

Mauricio Delgado, FIN

Michael Lee, FIN

Victoria Buckland, HHS

Trevor Ashbarry, OCA

Francisco daRosa, OIG

Megan Limarzi, OIG

Michael Goldfarb, OEMHS

Sarah Dickinson, OMB

David Gottesman, OMB

Katherine Medina, OMB

Thomas Tippett, OMB

Joshua Watters, OMB

Outside Jurisdictions and Organizations

Jeanet Kulcsar, Detroit, MI

Steven Wiltse, Detroit, MI

Outside Jurisdictions and Organizations (Continued)

Brian Wisnowski, Durham, NC

Joanne Cech, Fort Collins, CO

Cate Eckenrode, Fort Collins, CO

SeonAh Kendall, Fort Collins, CO

Sarah Meline, Fort Collins, CO

Melissa Cannon, Gilbert, AZ

Melanie Dykstra, Gilbert, AZ

Jennifer Graves, Gilbert, AZ

Evan Allred, Mesa, AZ

Jolene Pomeroy, Mesa, AZ

Alberta Benn, Philadelphia, PA

Jamila Davis, Philadelphia, PA

Jessica Hammond, Philadelphia, PA

Kenyatta Miller, Philadelphia, PA

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Ariel Bolingbroke, San Francisco, CA

Fiona McBride, San Francisco, CA

Danielle Gunn, Tempe, AZ

Wydale Holmes, Tempe, AZ

Pete Bernardy, Results 4 America

Jen Tolentino, Results 4 America

Section I. Brief Overview of Data Tracking and Usage in Local Government

Local governments collect and house troves of data related to the wide array of services they provide to their constituents. When harnessed effectively, data can streamline the delivery of public services, improve the quality and cost-effectiveness of public services, reduce duplication of efforts within and across departments, uncover opportunities for productive inter- and intra-departmental collaboration, and achieve other benefits.[4]

Many local governments have created open data dashboards that are intended to give the public a window into the workings of government. These dashboards typically allow visualizations of important government performance measures, such as fire and rescue response times, department operating budgets, and other community statistics.[5] Open data dashboards have increased government transparency while also fostering collaboration when, for example, departments collaborate to combine data to highlight government outcomes.[6]

Many local governments, however, remain far from harnessing data's full potential. A survey performed by MeriTalk, a public-private partnership that provides news and analysis on government information technology (IT), interviewed 150 state and local government IT and program managers. The survey found that while 89% respondents agreed data analytics is the "life blood of modern government," 63% of respondents said their governments remain in the early- to mid-stages of the analytics maturity model (i.e., a model commonly used to evaluate how organizations advance through stages of data analysis over time).[7]

Many local governments are significantly limited by the lack of an organizational-wide data governance strategy, which is a collection of laws, internal policies, procedures, and best practices that guide an organization's responsible use of data.[8]

One significant problem a data governance strategy can impact is data silos. Data silos exist when data collected and held by one group is not easily available or accessible to other groups in the same organization. Different departments often have inconsistent standards for data security, recording, formatting, and reporting and may use databases that are incompatible with other departments'

[4] Domeyer, Axel, Solveigh Hieronimus, Julia Klier, and Thomas Weber, Government Data Management for the Digital Age, McKinsey & Company, September 20, 2021.
[5] Pica-Alfano, Lindsay, Data 101: A Guide for Local Governments, Govlaunch.
[6] Black, Harry, Optimizing Local Government Management Through Performance and Data Analytics: The Cincinnati Experience, City of Cincinnati, May 9, 2017.
[7] Accelerating Data-Driven Government: Data Management and Analytics in State and Local Organizations, Meritalk, 2021; Christensen, Alex, "What is Analytics Maturity Framework?," phData, January 12, 2022.
[8] Brous, P., Janssen, M., Vilminko-Heikkinen, R., "Coordinating Decision-Making in Data Management Activities: A Systematic Review of Data Governance Principles," *Electronic Government*, 2016.

databases.[9] This prevents data sharing and collaboration across (and sometimes within) departments, agencies, and external partners, and can hinder the integration of data use into day-to-day government work and decision-making.[10] [11]

Tracking Use of Emergency Funds. The occurrence of an emergency at the federal, state, or local level can result in government disbursement of emergency funds to address the situation. After an emergency or disaster declaration is made at the federal level, for example,[12] federal, state, and local employees may work together to determine the level of financial assistance that is needed from FEMA.[13] The federal government may give emergency funds to state and/or governments for use in specific ways set by the federal government.

Governments providing emergency funds typically establish rules for how the funds can be used or who they can go to. A government agency spending those funds must balance the immediate need in the community with the time needed to ensure appropriate financial safeguards are in place to track spending of the funds. For funds ultimately given as grants to individuals or organizations, for example, safeguards can include the collection and tracking of data from applications (e.g., income, address) to ensure an applicant's eligibility to receive the funds.[14] However, eligibility requirements and government guidance on the use of funds can change rapidly during an emergency, making it difficult for government agencies using the funds to collect all necessary data to ensure compliance.[15]

Need for Internal Controls

A 2022 report from the U.S. Government Accountability Office (GAO) reflecting on ensuring transparency and accountability for emergency relief funds during the COVID-19 pandemic and beyond, found that there was a lack of internal controls, including data sharing and collection, that led to improper payments of emergency relief funds. One recommendation from the report was that agencies should develop internal control plans during non-emergency times that can be put to immediate use for future emergency funding. This plan included data tracking and collection strategies with an emphasis on reliable, quality data.[16]

[9] Kim, Gang-Hoon, Silvana Trimi, and Ji-Hyong Chung, "Big Data Applications in the Government Sector," *Communications of the ACM*, Vol. 57 No. 3, March 2014.
[10] Pica-Alfano, Data 101: A Guide for Local Governments.
[11] Rubin, Leslie, The Role of Chief Data Officers in Government, Office of Legislative Oversight, January 17, 2017.
[12] According to the Stafford Act, an "emergency means any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lesson or avert the threat of a catastrophe in any part of the United States."
[13] Maryland Emergency Management Agency, Local Elected Officials Guide to Emergency Management, A Center for Preparedness Excellence, April 2015.
[14] Dodaro, Gene L., Emergency Relief Funds, GAO, March 17, 2022.
[15] Ibid.
[16] Ibid.

Section II. Feedback from Other Jurisdictions

To identify promising practices regarding the use of data and evidence during emergencies, OLO interviewed personnel from nine local governments certified by What Works Cities. These jurisdictions went beyond publishing COVID-19 health data and tracked and reported on the use and performance of COVID-19 pandemic relief funds and programs. See Table 1 for the governments interviewed and selected dashboards/reports on relief programs they made publicly available. This section presents common themes OLO heard during the interviews regarding:

- The benefits of tracking and reporting on the use and performance of relief funds from an emergency response standpoint;
- The challenges of tracking and reporting data in an emergency context; and
- The lessons learned from the pandemic.

Table 1. Jurisdictions Interviewed by OLO

Jurisdiction	Selected Public-Facing Dashboards & Reports
Detroit, MI	▪ How Detroit's ARPA funds are being spent ▪ COVID-19 Financial Transparency
Durham, NC	▪ Emergency Rental Assistance Program
Fort Collins, CO	▪ CARES Act Dashboard ▪ CARES CVRF Funding Impact Report
Gilbert, AZ	▪ AZCares Act Funds ▪ Community Development Block Grant (CDBG)-CV
Mesa, AZ	▪ Mesa ERAP Dashboard ▪ Mesa Cares
Philadelphia, PA	▪ COVID-19 Emergency Rental Assistance Program ▪ Philadelphia COVID-19 Small Business Relief Fund
Rochester, NY	▪ COVID-19 Response: Total Meals Served
San Francisco, CA	▪ COVID-19 Alternative Shelter Program ▪ Homelessness Recovery Plan
Tempe, AZ	▪ Innovation in Advancing Community Health and Fighting COVID-19

Data Strategies During Nonemergency and Emergency Times

A. Benefits of Using Data and Evidence

The interviewees believe tracking and reporting on the use of relief funds and/or the performance of relief programs aided their respective government's response to COVID-19 in two critical ways. First, at the onset of the emergency, the jurisdictions leveraged their existing data infrastructures to inform leadership decision-making and to shape the initial development of key relief programs. In their view, using their pre-pandemic data infrastructure and processes allowed the jurisdictions to target early relief to residents and organizations with the greatest need for government assistance given the acute risks they faced.

Second, the interviewees stressed the benefit of using data insights throughout the course of the emergency to adapt government relief efforts to changing health and socio-economic conditions. In particular, the jurisdictions used data insights to track residents and organizations that continued to need government assistance, to remove barriers to access, and/or to adjust eligibility requirements for certain relief programs.

Several interviewees also commented that reporting on the use of relief funds helped keep residents informed about government actions during the pandemic.

B. Common Challenges

Though beneficial overall, tracking and reporting on relief funds and programs presented several common challenges for the local governments interviewed.

One common challenge was building the data infrastructure to implement relief programs while implementing the programs. As several interviewees said, "we were building the airplane while flying it." According to certain interviewees, time constraints meant data analyst teams had to standardize data collection processes, establish data sharing processes with agencies and third parties, fix avoidable data collection errors and process inefficiencies, and identify performance metrics – all while relief programs were being implemented.

Building the data infrastructure was particularly challenging for relief programs funded with federal and state grants. Federal and state agencies often released program guidance after releasing funds and changed funding requirements over time. As a result, jurisdictions did not know all data collection requirements for grant compliance when developing and implementing applications and systems. Consequently, program and data analysis teams had to modify applications and data collection systems and processes as federal and state guidelines changed during the pandemic.

Jurisdictions also faced training and staffing constraints. To quickly implement relief programs, many jurisdictions had to reassign staff duties and responsibilities within and between agencies. Jurisdictions had to train staff on new administrative and operational functions, comply with new and often changing federal and state grant requirements, and monitor third-party compliance. Tracking the use and performance of relief funds beyond what was needed to meet basic grant and legal requirements required data analysts to provide additional training to program administrators during a period of

extensive training and workload demands. Training needs were particularly high within departments and third-party partners in which data literacy among staff was relatively low.

C. Lessons Learned

Jurisdictions saw numerous benefits from tracking and reporting data during an emergency and gained insight on how to address various challenges in preparation for future emergencies. Interviewees emphasized the role of government- and department-level leadership for their success in tracking and reporting on the use and performance of relief programs. Because leadership had already committed to building a data-driven culture prior to the emergency, these jurisdictions understood the value of adopting a data and evidence approach to the pandemic. Interviewees generally credited a mayor- or executive-led central emergency recovery team with providing the data analytic teams the authority needed to work effectively.

Interviewees identified four features of data infrastructure that were helpful to have established prior to the emergency:

- A common framework or language for program evaluation and impact assessment (e.g., definitions of demographic and household characteristic variables);
- A data inventory as part of the process of data centralization to tap into existing data;
- Existing data sharing processes for program evaluation, both with internal and external partners; and
- Data owners in every department.

The jurisdictions' history of ongoing cross-departmental data collaboration was critical to breaking down silos, developing buy-in, building data literacy, and identifying areas that needed additional resources to effectively use data.

Furthermore, interviewees emphasized the importance of involving data analysts in the early stages of program development to:

- Assess data capabilities of agencies and staff implementing relief programs;
- Develop program performance metrics;
- Identify data collection requirements prior to developing applications; and
- Develop standardized online applications.

According to some interviewees, failure to involve data analysts at the front-end resulted in data collection errors, unnecessary duplications in processes, and other inefficiencies that were challenging to address after programs began.

Interviewees also stressed the importance of:

- Assessing third parties' data capabilities before awarding contracts and including rigorous data evaluation standards in contracts;
- Including all relevant public and private stakeholders in program development;
- Aligning emergency funds with existing government priorities and performance measures; and
- Learning from other jurisdictions and industries' data-driven pandemic responses.

Section III. Promising Practices in Data Collection, Tracking, and Analysis

There is little literature on how local governments should use data to improve emergency response. OLO identified promising practices in data collection, tracking, and analysis from a review of the literature on data-driven and evidence-based policy and practice and by drawing on its findings from the feedback presented in Section II from jurisdictions that took a data-driven response to COVID-19.

OLO's review of the literature confirmed a key observation raised by stakeholders presented in the previous section. Developing strong organizational data collection, analysis, tracking practices during "normal" times is necessary to harness data during an emergency to aid in the recovery process.[17] To illustrate, a 2018 paper written after the World Health Organization (WHO) brought together leading experts to identify key research needs identified substantial gaps in best practices for data collection during emergencies. One of the findings was that proper collection of baseline data before the disaster is essential to conduct efficient disaster relief and recovery activities.[18]

This section is organized around the following major topic areas for promising practices in data collection, tracking, and analysis.

A. Creating a Data Driven Culture

B. Centralizing Emergency Response and Recovery

C. Early Development of Program Eligibility and Processes

D. Performance Indicators and Metrics

[17] Cheatham, Ben, Ann Healy, and Becca O'Brien Kuusinen, Improving Disaster Recovery: Lessons Learned in the United States, McKinsey & Company, June 2015; Kubo, Tatsuhiko, Alisa Yanasan, Teodoro Herbosa, Nilesh Buddh, Ferdubak Fernando, and Ryoma Kayano, "Health Data Collection Before, During and After Emergencies and Disasters—The Result of the Kobe Expert Meeting," *Int J Environ Res Public Health*, 2019, Vol. 16 No. 5: 893; Federal Emergency Management Agency, Disaster Financial Management: Guidance for State, Local, Tribal, & Territorial Partners, April 2020; Kanowitz, Stephanie, "Why Data Drills Should Be Part of Emergency Planning," GCN, September 24, 2020; Mashariki, Amen Ra, "We Have Fire Drills, Why Governments Need to Run 'Data Drills' As Well," Beek Center, Georgetown University, May 27, 2020.

[18] Kubo, et al, "Health Data Collection Before, During and After Emergencies and Disasters."

A. Creating a Data Driven Culture

An organization with a data-driven culture uses data as the universal basis for decision making when appropriate.[19] In government, the benefits to data-driven decision making include:

- Increased effectiveness in program delivery;[20]
- Targeted aid for residents and neighborhoods; and[21]
- Concrete evidence to back up complex policy decisions.[22]

A data-driven culture requires buy-in and explicit support from government leadership regarding the benefits of data and evidence.[23] Support from leadership establishes the credibility and authority required to cultivate a deeper and more advanced use of data throughout an organization.[24] With leadership support firmly established, jurisdictions can take steps to cultivate a data-driven culture throughout the government. Small changes such as integrating data into daily work and work discussions can help personnel embrace a data-driven culture.[25]

A key to driving this process is having solid, useable data. The rest of this subsection describes areas where governments can make significant improvement by fixing common data-access and -use limitations:

- **Data Inventory.** Identify where all existing data is, who is the creator of the data, and who owns the data (meaning one who stores the data in question) through a data inventory. Establish a baseline of what is already collected so there is not a duplication in efforts when suggesting new data to collect and track.[26]

- **Data Cleaning and Quality.** Data are only useful when they are accurate, reliable, and standardized. When data points are missing, misspelled, or reported differently across departments (i.e., alternating between using a 5 digit and 11-digit Federal Information Processing Standard code), the information is less useful and takes more time and staff to get it to a usable data point.[27]

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[19] Waller, David, "10 Steps to Creating a Data-Driven Culture," Harvard Business Review, February 6, 2020.
[20] Mahesh, Kelkar, Sean Conlin, Peter Viechnicki, and Rachel Frey, "Mission Analytics: Data-Driven Decision Making in Government," Deloitte, September 26, 2016.
[21] Coulthard, Tim, "The Essential Guide to Data-Driven Government," Government Transformation Magazine, March 1, 2022.
[22] Huh, Kil, Amber Ivey and Dan Kitson, "Using Data to Improve Policy Decisions," Pew, August 14, 2018.
[23] Leaders includes not only department heads but line managers as well.
[24] Poftak, Steve, "City Hall's Technology Journey: Using Data to Improve the Lives of Citizens," Rappaport Institute for Greater Boston, Harvard Kennedy School, April 2016; The-atlas.com, "ARPA Dashboard Tracks Budget and Spending in Syracuse's Priority Areas," The Atlas, April 29, 2022.
[25] Day, Jennifer, "How to Harness a New Wave of Data-Driven Decision Making," Forbes, July 30, 2021.
[26] Blauer, Beth, "Building the Data City of the Future," *The ANNALS of the American Academy of Political and Social Science*, 2018, Vol. *675* No. 1, 151–165.
[27] Huh, et al, "Using Data to Improve Policy Decisions."

- **Data Literacy Training.** All employees should have a baseline knowledge of data literacy and an understanding of why it is relevant to their role and department.
- **Deep and Persistent Cross-Departmental Data Collaboration.** Creating mechanisms to communicate and share data across departments can help staff identify duplication of efforts and find opportunities to collaborate.

Data Inventory. Governments have a wealth of data and Montgomery County is no exception.[28],[29] A complete data inventory should include at minimum the source of data, frequency of updates, system of origin, and data fields.[30] A small way to begin a data inventory process is for departments to choose key questions to be answered regarding programs, missions, and goals and then decide what data are needed to answer these questions. This can help departments sift through data that already exists, inventory data, and use it in a meaningful way.[31]

Data Cleaning and Quality. Governments cannot use data in meaningful ways if they lack clean and quality data.[32] Data quality looks at multiple facets of data, including:

- **Validity** - The degree to which the data conform to defined organization rules or constraints, such as phone numbers having a specific pattern (I.e., (999) 999 – 9999).
- **Accuracy** - The degree to which the data is close to the true values. For example, capturing an address accurately entails listing an apartment number, if needed, including a zip code, and correctly recording street names and numbers.
- **Completeness** - The degree to which all required data is known.
- **Consistency** - The degree to which the data is consistent within the same dataset or across multiple data sets and that values do not contradict each other.
- **Uniformity** – The degree to which the data is specified using the same unit of measure (i.e., measuring distance in miles vs. kilometers).

Taking steps to ensure the collection of clean, quality data that is standardized and easily accessible to users can improve efficiency and collaboration throughout an organization.[33] [34]

[28] Stakeholder Feedback
[29] Huh, et al, "Using Data to Improve Policy Decisions."
[30] Blauer, Beth, "Building the Data City of the Future."
[31] Jacques, Lindsay, "Cox's Pathways to Effective Use of Data: Four Opportunities to Take the Road Less Traveled," ICMA, September 25, 2020.
[32] Elgabry, Omar, "The Ultimate Guide to Data Cleaning," Towards Data Science, February 28, 2019.
[33] Ibid.
[34] Gil-Garcia, Ramon and Djoko Sayago, "Government Inter-Organizational Information Sharing Initiatives: Understanding the Main Determinants of Success," *Government Information Quarterly*, 2016 Vol. 33 No. 3, 572-582.

Data Literacy Training. Data literacy is defined as the ability to speak, read, and write data, and to translate it into actionable information.[35] Numerous sources stress the importance of data literacy across an entire organization[36] as opposed to limiting data use to a handful of employees in a given department who are the only ones trained in this work.

Sources emphasize the need for employee trainings that include: 1) software use and technical skills; and 2) data vocabulary and establishing a common language amongst employees.[37] The Federal Data Strategy 2020 Action Plan directs all federal agencies to conduct a gap analysis of skills to see where weaknesses and training needs lie.[38] The analysis has four major components:

- Identify critical data skills needed for the agency;
- Assess the current staff capacity for those data skills;
- Perform a data skills gap analysis to prioritize the agency's needs; and
- Identify and execute approaches to fill those needs.[39]

Training all employees in a department's data and use of data can aid in problem-solving. For example, training government attorneys about a department's data and use of data for problem solving can facilitate work on policy changes to allow data sharing and help them move away from a common focus on existing restrictions on data sharing.[40]

Deep and Persistent Cross-Departmental Data Collaboration. In large organizations like local governments, departments often do not fully understand the range of each other's services or what data they hold. Creating mechanisms to foster regular communication between departments can help employees identify new ways to work together to further their missions.[41]

One way to develop this collaboration is to create an easily accessible central database that all departments can access. OLO Memorandum Report 2017-6, The Role of Chief Data Officers in Government, found that many organizations and governments generate isolated datasets that cannot be used together across departments. However, with a unified data strategy, it is possible to de-silo these data.[42]

[35] Barrett, Randy, "Data Literacy in Government: How Are Agencies Enhancing Data Skills," FedTech, July 26, 2021.
[36] Blauer, Beth, "Building the Data City of the Future."
[37] Churchill, Andrew, "5 Strategies for Building a Culture of Data Literacy," Nextgov, November 26, 2019.
[38] Strategy.data.gov, Federal Data Strategy: 2020 Action Plan, President's Management Agenda.
[39] Ibid.
[40] Blauer, Beth, "Building the Data City of the Future."
[41] Jachimowicz, Maia, Sophie Bergmann, and Jennifer LaMotte, Montgomery County, MD Connects Frequent 911 Callers to Comprehensive Support, Results 4 America, September 26, 2018.
[42] Rubin, Leslie, The Role of Chief Data Officers in Government.

Expanding data access across departments can help break down major barriers described in an article published by the Government Accountability Office that include:[43]

- Lack of knowledge and/or awareness of datasets within and outside of their departments;
- Lack of knowledge of getting data out of information systems;
- No established standard process for requesting data;
- Not knowing who to contact to request data; and
- Data not available in digital form.

Considerations for Moving to a Data Driven Culture

Local governments can move toward a data driven culture by creating a general language in how the County thinks and speaks about data. Many sources suggest general questions that all employees and departments can consider when setting up data collection and analysis processes.[44] Developing a framework of general questions based around buckets of information that departments want to use can help employees think through which data are already available and which data are still needed. For example, if a program wants to focus on strong outreach, it can collect data that can answer questions like "Who is receiving outreach?" and "What type of outreach is being conducted?" The Appendix at the end of this report includes lists of example questions based on literature reviews and stakeholder interviews.[45]

Additional key considerations include assessing the "maturity" of data – or its readiness to be applied in decision-making. The table on the next page includes a piece of the University of Chicago's data maturity framework, which can provide a framework for departments to assess the readiness of their data.[46] The full framework is in the Appendix at the end of this report.

[43] Government Accountability Office, Public Health Emergencies: Data Management Challenges Impact National Response
[44] Blauer, Beth, "Building the Data City of the Future."
[45] Ellen, Ingrid, Claudia Aiken, and Andrew Aurand, Advancing Racial Equity in Emergency Rental Assistance Programs, NYU Furman Center, March 2021; Cheatham, Ben, et al, Improving Disaster Recovery; Government Accountability Office, Public Health Emergencies: Data Management Challenges Impact National Response
[46] Data Maturity Framework, Data Science and Public Policy, Carnegie Mellon University.

	Area	Lagging Maturity	Basic Maturity	Advanced Maturity	Leading Maturity
How is Data Stored?	**Accessibility**	Only accessible within the application where it is collected	Can be accessible outside the application but is in proprietary format	All machine readable in standard open format (i,e., CSV, JSON, XML)	All machine readable in standard open format and available through an API
	Storage	Paper	PDFs or Images	Text Files	Databases
	Integration	Data sits in the source systems	Data is exported occasionally and integrated in an ad hoc manner	Central data warehouse – Realtime aggregation and linking	External data also integrated

B. Centralizing Emergency Response and Recovery

Expert guidance indicates that having a central team for emergency response and recovery efforts is crucial. This section summarizes benefits of central recovery teams that prioritize data-driven decision-making during emergency response and recovery efforts.

An article from Mckinsey and Company emphasizes the importance of creating a strong and experienced leadership team in response to an emergency to gain support of the public, other government agencies, and other funders of disaster recovery activities.[47] This leadership team can help coordinate recovery programs that have direct accountability to high-level government leadership.[48]

The Federal Emergency Management Agency (FEMA) asserts coordinating and directing emergency response and recovery through a central leadership team is essential.[49] Primary functions of a centralized leadership team can include:[50]

- Collecting, analyzing, and sharing information;
- Supporting resource needs and requests, including allocation and tracking;
- Coordinating plans and determining current and future needs; and
- Providing coordination and policy direction.

[47] Cheatham, Ben, et al, Improving Disaster Recovery.
[48] Ibid.
[49] Federal Emergency Management Agency, Emergency Operations Center How-to Quick Fix Reference Guide.
[50] Ibid.

FEMA also recommends creating a jurisdiction-wide centralized repository for expenses to access and assemble documentation more efficiently.[51]

Other opportunities for centralizing response and recovery include developing a team of senior staff to implement real time central tracking on the disbursement of all funds. This team would compile all information about sources and amount of aid, grants, and loans received, including information on applications received, status of application review, and approval/denial decisions. The team should include individuals with IT and grant-management skills and experience to ensure that data is being collected and utilized correctly while also understanding relevant processes and policies in the organization.[52] All relevant government departments can create and report key performance indicators on relief programs to the centralized team.

C. Early Development of Program Eligibility and Processes

Developing data systems to track information during emergency times requires infrastructure to establish processes and collect data that builds in flexibility to adjust for unusual circumstances while providing as much aid for those who need it.[53] This section describes some strategies to achieve these end goals.

Experts recommend tracking data from the very beginning of an emergency to look at patterns that may suggest opportunities for course corrections in the middle of a program.[54] For example, if too many aid applicants are rejected because they are above a standard for eligibility, it may make sense to lower the eligibility standards to distribute more aid to those who need it.

Jurisdictions should develop a framework to prioritize recovery needs and identify (and potentially accelerate) the most critical relief programs. Certain needs are more immediate than others, such as food and housing. By tapping into existing GIS and demographic data, program administrators can know which neighborhoods and population segments are most vulnerable and can align the program to prioritize those needs.

[51] Federal Emergency Management Agency, Disaster Financial Management.
[52] Bloomberg Philanthropies, COVID-19 Municipal Resource Guide, The United States Conference for Mayors.
[53] Wisconsin Hope Lab and Scholarship America, Investing in Student Completion: Overcoming Financial Barriers to Retention Through Small Dollar Grants and Emergency Aid Programs.
[54] Ellen, Ingrid, et al, Advancing Racial Equity in Emergency Rental Assistance Programs.

D. Performance Indicators and Metrics

Performance measurement is directly linked to strategic planning and cannot be effective without setting specific goals linked to an organization and its departments' mission. In general, key performance indicators (KPIs) are sets of data that allow organizations to compare its performance against itself over time and compare itself to peer organizations.[55] While Montgomery County already tracks and reports performance indicators, it could be helpful to look at current practices and evaluate existing performance indicators.[56]

Many governments, including Fairfax County, use a four-step methodology to develop performance metrics:

STEP 1. Review and evaluate existing department mission and cost center goals

- Goals should be linked to the department mission and give specific direction on how the department will achieve the stated mission over multiple fiscal years. A good goal statement should include: (1) Beginning with "To" followed by a verb (2) What the department or program area does (3) Identify its customers and stakeholders (4) State "why" the program or department exists (5) Be associated with an outcome indicator.
- Example: Maternal and Child Health Services: "To provide maternity, infant, and child healthcare and/or case management to at-risk women, infants, and children in order to achieve optimum health and wellbeing."

STEP 2. Identify a service area

- Employees should identify the department's major activities. Some questions to consider are: (1) Is the action critical to the success of the department's mission? (2) Does it consume a significant portion of the budget? (3) Is it locally sensitive or in the public spotlight? (4) Does it have a significant customer service focus?

STEP 3. Generate service area objectives

- Objectives should be outcome-based statements on goals within a given budget year. Generally, the objective should address the department's goal statement, reflect planned benefits to customers, allow measurement of progress, and be quantifiable within a fiscal year time frame.

[55] Montgomerycountymd.gov, CountyStat: Indicators.
[56] Montgomerycountymd.gov, Department Performance Dashboards.

- Example: Fire Services - Reduce average response times to 7 minutes or less within the municipal limits.

STEP 4. Identify indicators that measure progress on objectives

- Indicators should be used to report performance at a glance. There should be an indicator for each of the following: output, efficiency, service quality, and outcome. When developing indicators, it can be helpful to ask how you can measure whether our team and/or department is meeting the service area objectives.

The City of Rochester, New York takes an iterative approach to link performance indicators to broader city goals. Department leadership reviews their key performance indicators each budget season to ensure they are the right indicators to focus on and that they link to a goal or strategy in the city's comprehensive plan. Some questions that leadership use to frame their evaluations include:

Relevance

- Are the indicators still focused on matters of strategic importance?

Targets

- Are we setting realistic, challenging goals for "what good looks like"?

Data Quality/Availability

- Do we have good ways to measure our results?

Governments may face pushback when developing new performance programs. Employees can experience "reporting fatigue" – where data producers and frontline employees can look at performance programs as extra work with little return. Including frontline employees and data producers when developing new performance programs can ensure the programs are connected to frontline realities and the performance measures and data requests include relevant contextual information.[57]

[57] Blauer, Beth, "Building the Data City of the Future."

Section IV. Montgomery County

County staff report that County departments collect, use, and work with data in an ad hoc manner, meaning that each department creates, maintains, and publishes data differently in a generally nonscheduled way. Montgomery County has over 30 departments and agencies and a recent inventory revealed there are almost 700 County systems and applications utilized for data purposes, such as collection, tracking, and analysis.[58] Staff further report most departments store their own data (the data is decentralized), except for County financial data which is centralized and available to staff throughout the County.[59]

Due to its size, decentralization, and other factors, Montgomery County has fragmented data resources – or data silos – where data cannot be easily shared or used across departments, or in some cases, across programs in the same department.[60] These silos make it difficult to fulfill data requests and require more staff time to manually process and clean data. To address these issues, CountyStat (described below) has created a Data Stewards group. The group provides a point of contact among data analysts for each department and is actively working on ways to improve data sharing processes in the County.

CountyStat is Montgomery County's performance management and data analytics team. The office provides data guidance to County departments and leads various data-related projects. CountyStat's website houses many data projects.[61] For example, County departments' performance measures are annually tracked and reported on the CountyStat website.

Each department identifies specific programs to be measured. A program is an activity or set of activities performed by the County that has: (1) identifiable costs for budgeting purposes; (2) a clear public purpose and measurable results; and (3) clear lines of accountability for its performance and financial management.

Montgomery County measures program performance by asking three questions:

1. How much did we do? (Quantity)
2. How well did we do it? (Quality)
3. Is anyone better off? (Effect or Impact)[62]

[58] Ibid.
[59] Ibid.
[60] Stakeholder Feedback
[61] Montgomerycountymd.gov, CountyStat.
[62] Montgomerycountymd.gov, Department Performance Dashboards.

Other open data presented by CountyStat include community dashboards that combine internal administrative data and data from partners to examine County demographics and community assets. Some specific datasets and data visualizations published include:

- **Regional Service Areas Mapping** displays different data points (demographics, population density) for regional service areas in the County;
- **COVID-19 Surveillance** displays relevant metrics used to track the spread of COVID-19 in the County;
- **Food Security** explores data pertaining to County residents who are food insecure and efforts taken by the County and community to combat hunger; and
- **Hidden Hardships** explores trends in data of County residents living in poverty.

Montgomery County Emergency Fund Tracking During the COVID-19 Pandemic

The Montgomery County Charter provides a mechanism to expedite appropriations for relief programs during a state of emergency. Section 308 of the Montgomery County Charter provides that "[a] special appropriation is an appropriation which states that it is necessary to meet an unforeseen disaster or other emergency, or to act without delay in the public interest. Each special appropriation shall be approved by not less than six Councilmembers. The Council may approve a special appropriation at any time after public notice by news release. Each special appropriation shall specify the source of funds to finance it."[63]

During the COVID-19 pandemic, the County used Charter Section 308 to expedite the release of assistance funds to County residents. Due to the speed of incoming relief funds from federal and state governments, County departments had to quickly create grant programs with eligibility guidelines. The Montgomery County Office of the Inspector General (OIG) conducted reviews of some of the COVID relief programs. The reviews found that due to the expedited nature of these programs, some programs had administrative issues, such as changes to eligibility criteria that could result in potentially qualified applicants missing the opportunity to apply.[64]

Further, the Executive Branch brought in staff from various County departments to process relief program applications but provided insufficient training for many of these staff. This led to inconsistent and improper evaluation methods, data entry, and determinations of eligibility for applicants.[65] Best

[63] Section 308. Special Appropriations, Charter of Montgomery County, Maryland.
[64] Limarzi, Megan, COVID-19 Rental Assistance Programs, Office of the Inspector General, Montgomery County, Maryland.
[65] Office of the Inspector General, Lessons Learned from COVID-19 Grant Programs, Montgomery County, Maryland.

practices in data collection and tracking emphasize the importance of having standardized practices in place for any employee that collects and reports data.[66]

County staff report the federal government did not provide guidance on the data that should be collected to determine program eligibility until a year after Covid-19 began. Staff report departments erred on the side of caution and staff tagged any data with a COVID code they thought would be used to track COVID relief program eligibility. When federal guidance was released, it was more restrictive than anticipated, and there was a wealth of data that had to manually be sorted through.

CountyStat representatives report examples of quality data use during the pandemic. Examples include the County's use of existing data to establish priority areas for rental relief based on census demographics data and to establish priority areas for vaccination.

After Action Reports

The County utilizes data collected in emergency times in After-Action Reports written by the Office of Emergency Management and Homeland Security (OEMHS). These reports detail emergency events, analyze the response, and identify areas for improvement in future events.[67]

Section V. Findings and Discussion Items

The County Council has asked the Office of Legislative Oversight (OLO) to examine how County agencies could collect and track data related to emergency relief funds in a way that would not delay the flow of funds in future emergencies. In other words, how the County can reduce, if not eliminate, the tradeoff between the rapid disbursal of funds and program effectiveness and efficiency described above. To this end, this memorandum report identifies "promising practices" (i.e., policies and practices supported by the best available evidence) the County can draw on to improve its tracking and reporting of data on relief programs in future emergencies.

Developing the infrastructure for a data-driven culture takes focused planning and resources.

This memorandum report draws from literature on best practices and from interviews with other local jurisdictions and describes ways local governments can harness data to improve service delivery, identify gaps in services, and foster collaboration among departments. OLO identified nine local jurisdictions that both possessed the What Works Cities Certification and applied an expanded data and evidence approach to their pandemic responses (i.e., these jurisdictions went beyond tracking and

[66] Blauer, Beth, "Building the Data City of the Future."
[67] Stakeholder Feedback

reporting on health-related metrics and published publicly available dashboards or reports detailing the use of relief funds and/or performance of relief programs).

This section summarizes OLO's five findings and three recommendations for Council consideration.

Findings

Finding # 1. According to interviews with other jurisdictions and literature on promising practices, establishing a government-wide data strategy during non-emergency times is key to responding quickly and accurately with a data-driven approach in emergency times.

At the beginning of the COVID-19 pandemic, the jurisdictions interviewed by OLO leveraged their existing data infrastructures to inform leadership decision-making and to shape the initial development of key pandemic relief programs. Representatives from these jurisdictions reported the primary benefit of using their pre-pandemic data infrastructure and processes was it allowed them to use data to target early relief to residents and organizations that the jurisdictions had already determined had the greatest need for government assistance.

Finding # 2. Using data effectively during an emergency requires having developed a robust data infrastructure and a data-driven culture during normal operations.

OLO found through a review of literature and interviews with other jurisdictions that developing strong organizational data collection, analysis, tracking practices during "normal" times is necessary to harness data during an emergency to aid in the recovery process.

Local governments can build the infrastructure and culture by establishing a data inventory, improving the cleanliness and quality of data, providing data literacy for all employees to develop a baseline knowledge of data and its uses, and developing mechanisms for deep and persistent collaboration and data sharing between and within departments.

Finding # 3. Expert guidance indicates that having a central recovery team for emergency response and recovery efforts are crucial.

Guidance from the Federal Emergency Management Agency (FEMA) highlights that having a central organization where government leaders can coordinate and direct emergency efforts is essential for response and recovery from an emergency. As large local governments are susceptible to the practice of keeping access to data strictly within the department that collects the data (data silos), creating a data sharing culture across all departments can break down these silos and lead to better communication across the organization. This can in turn, make it easier to launch a centralized response when emergencies occur.

Data Strategies During Nonemergency and Emergency Times

Finding # 4. When emergency relief funds are released, government agencies must balance the rapid release of funds while ensuring appropriate financial safeguards are in place.

During emergencies, government agencies must quickly set up programs to disperse relief funds and establish eligibility requirements to receive funds. This process can be time-consuming, especially during an emergency where the goal is to disperse as many funds to as many eligible applicants as quickly as possible. The Federal Government Accountability Office recommends jurisdictions develop organization-wide internal control plans during non-emergency times that can be put to immediate use to disburse funding when an emergency develops. This includes having the needed infrastructure already in place to effectively and accurately track program data.

Finding # 5. Montgomery County staff report that in general, departments work with data in an ad hoc manner, meaning each department creates, maintains, and publishes data differently in a generally nonscheduled way. This can lead to noninteroperable data silos.

Montgomery County has over 30 departments and agencies and a recent inventory revealed there are almost 700 County systems and applications utilized for data purposes, such as collection, tracking, and analysis. Staff further report most departments store their own data (the data is decentralized), except for County financial data which is centralized and available to staff throughout the County. Montgomery County's data silos result in data that cannot be easily shared or used across departments, and in some cases, across programs within the same department.

The Montgomery County Office of the Inspector General (OIG) conducted reviews of some of the COVID-19 relief programs. The reviews found that due to the expedited nature of these programs, some programs had administrative issues, such as changes to eligibility criteria that resulted in potentially qualified applicants missing the opportunity to apply. Further, the Executive Branch brought in staff from various County departments to process relief program applications but provided insufficient training for many of these staff. This led to inconsistent and improper evaluation methods, data entry, and determinations of eligibility for applicants.

Recommendations

The following recommendations are aimed at improving the County's data culture to aid in a more centralized and data-driven emergency response.

Recommendation # 1. Ask the County Executive to develop and implement a data centralization strategy to expand the County's capacity for cross-departmental data sharing.

In a large organization like Montgomery County, there are countless data sets across departments that can be harnessed to create more efficient and effective programs. By creating mechanisms to foster regular communication between departments, employees can better understand how their respective departments can work together to further their missions.

OLO found that one of the County's biggest issues in data sharing and collaboration is that departments have data silos. Data silos exist when data collected and held by one group is not easily available or accessible to other groups in the same organization. Different departments often have inconsistent standards for data security, recording, formatting, and reporting and may use databases that are incompatible with other departments' databases. This prevents data sharing and collaboration across (and sometimes within) departments, agencies, and external partners, and can hinder the integration of data use into day-to-day government work and decision-making.

The Council should ask the Executive Branch to bring together relevant interdepartmental representatives, including information technology professionals, to work through the specifics of a data collection and centralization strategy. The strategy should also include a coordinated effort for each department to develop a formal data request process and name contact(s) to serve as data liaisons to make it easier to share data across departments.

Recommendation # 2. Ask the County Executive to develop a general framework for collecting data that every department can refer to when setting up programs and developing performance indicators.

Best practices stress the importance of organization staff having a shared understanding of what data is and what it can do, in addition to a shared language to speak about data. One method of developing a framework is to establish universal questions that every department can use to set up data collection and tracking for programs.

Developing universal questions can aid staff in cultivating a better understanding of the data needed to answer the questions. Organizations can develop questions formed around buckets of information that departments need to collect based on, like reporting guidelines or information needed to track program outcomes. For example, if a program wants to evaluate its outreach, it can collect data that

can answer questions like “Who is receiving outreach?” and “Did the outreach cause individuals to apply for the program?”

Recommendation # 3. Ask the County Executive to conduct data literacy training that focuses on creating a County-wide language/framework for thinking about data and includes courses for competency in software and analysis techniques.

Data literacy is defined as the ability to speak, read, write, and translate data into actionable information. Promising practices indicate it is important for all employees to increase their data literacy to and data capacity across the entire organization. The Federal Data Strategy 2020 Action Plan directed all federal agencies to conduct a gap analysis of data skills to see where weaknesses and training needs lie.

The Council should ask the Executive to consider a similar County-wide initiative to identify needed training that would be most beneficial to increase data literacy across County departments. Some suggestions for training topics include data vocabulary, data analysis skills, and data story telling.

Appendix

It may be difficult or even impossible to come up with universal data points that each program should collect, as programs are varied in eligibility criteria, services rendered, and data points collected. Instead, it may be more helpful to create a general language in how the County thinks and speaks about data. Many references suggest general questions that all employees and departments can consider when setting up data collection and analysis processes.[68]

A framework of general questions that allows departments to think through data is a part of a formal data management strategy. There can be a series of questions based around buckets of information that departments want to collect. Employees can think through these questions to decide which data is already available and what should be collected to answer them. Programs are vast and varied and there are many ways of examining the effectiveness of a given program. For example, if a program wants to focus on strong outreach, it can collect data that can answer questions like "Who is receiving outreach?" and "What type of outreach is being conducted?"

Based on literature reviews and stakeholder interviews, OLO identified the following questions as strong examples of what to ask in developing a framework.[69]

General Questions to Consider
1. What matters most to us now at a strategic level?
2. What matters most to our citizens?
3. Why is carrying out this project important to the County?
4. What are the most significant problems/opportunities for which we have responsibilities?
5. What things can we control/make an impact?
6. Who are your clients? Who benefits from the work your department and/or program does?
7. What desired outcome(s) are you trying to achieve?
8. What evidence will convince you and others that the desired outcomes are being achieved over time?
9. For outside funded projects, do you foresee recurring costs/costs that extend beyond the funding window? How will they be paid?

[68] Blauer, Beth, "Building the Data City of the Future."
[69] Ellen, Ingrid, Claudia Aiken, and Andrew Aurand, Advancing Racial Equity in Emergency Rental Assistance Programs, NYU Furman Center, March 2021; Cheatham, Ben, et al, Improving Disaster Recovery;
Results for America, Five Ways Governments Can Make the American Rescue Plan Work for All.

Baseline Data Questions
1. For new programs, how did you decide the program was needed?
2. For existing or continuing programs, what data do you have that can provide a baseline to compare against how the program is doing now?
3. Who is the target population for your program and what demographic information will you capture on the target population?
4. What questions and information are required by grants and what information is requested on the application?

Outreach Data
1. Who and where receives outreach?
2. How frequently is outreach done and where?
3. What type of outreach is done? (i.e., phone calls, emails, posters, face-to-face)
4. For those who are applying, do they reside in targeted neighborhoods for outreach?

Application Data
1. Who submits a completed application?
2. Who submits an application with incorrect or incomplete documentation requirements?
3. Who drops out of the application process and why?
4. Who receives funding and the amount of funding awarded?

Reporting Requirements Data
1. What does our local open data policy require?
2. What do our state and federal grants require us to report?
3. What do the state and national organizations we belong to require us to report?
4. What do the state and federal laws require us to report?
5. What data do we collect related to our strategic priorities?

Data Strategies During Nonemergency and Emergency Times

Further, once data is identified to collect, it can be helpful to assess the "maturity" of the data, or its readiness to be applied in decision-making. Using a data maturity framework to assess data readiness, such as the University of Chicago's on the next page, can aid in providing a general framework for departments to think through and assess their data.[70]

Category	Area	Lagging	Basic	Advanced	Leading
How is Data Stored?	**Accessibility**	Only accessible within the application where it is collected	Can be accessible outside the application but is in proprietary format	All machine readable in standard open format (I,e., CSV, JSON, XML)	All machine readable in standard open format and available through an API
	Storage	Paper	PDFs or Images	Text Files	Databases
	Integration	Data sits in the source systems	Data is exported occasionally and integrated in an ad hoc manner	Central data warehouse – Realtime aggregation and linking	External data also integrated
What is Collected?	**Relevance and Sufficiency**	Data collected on subjects of interest is irrelevant to the problem you want to solve	Some of the data is relevant, but is insufficient as key fields are missing	Data is helpful and relevant for solving the problem but insufficient to solve it well	All data is relevant and it's sufficient to solve the problem
	Quality	Missing rows (address missing in the data)	Missing columns (variables missing)	No missing data but errors in data collection such as typos	No missing data and no errors in data collection
	Collection Frequency	Once and never again	Yearly	Frequently	Realtime
	History	No history kept – old data is deleted	Historical data is stored but updates overwrite existing data	Historical data is stored and new data gets appended with timestamps	All history is kept and new data format gets mapped to old format so older data can be used
Other	**Privacy**	No privacy policy in place	No PII can be used for anything	Ad-hoc approval process in place that allows selected	Controlled privacy protection that allows analytics to

[70] Data Maturity Framework, Data Science and Public Policy, Carnegie Mellon University.

				PII data to be used for approved projects	be done while preserving privacy
	Documentation	No digital documentation or metadata: data exists but field descriptions or coded variables are not documented	Data dictionary exists (variables and categories defined)	Data dictionary plus full metadata available (including conditions of when data was captured)	Data dictionary plus full metadata available (including potential bias)