



Modernizing Data Systems in Environmental Public Health: *A Blueprint for Action*

Acknowledgements

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Foreward

The environmental public health (EPH) landscape is evolving, driven by complex environmental health challenges and an increase in the frequency of public health emergencies. These challenges call for faster, more coordinated, and more data-driven responses than ever before. In some cases, EPH agencies operate with older data systems and limited technological capacity, which could limit their ability to maximize public health impact.

The Centers for Disease Control and Prevention (CDC), aware of these issues, has made data modernization a national public health priority. Through its Data Modernization Initiative (DMI), CDC has raised the importance of integrated, real-time, and interoperable systems that enhance public health surveillance, decision-making, and response capabilities across various disciplines, including environmental health.

The National Environmental Health Association (NEHA) conducted a comprehensive data and informatics needs assessment in 2023 to better understand the specific data and informatics challenges faced by EPH professionals. The results indicated significant gaps in technical infrastructure, workforce capacity, data accessibility, and interoperability—issues that span rural, urban, tribal, and territorial jurisdictions. These insights underscore the need for customized guidance to assist agencies at all levels in navigating the path toward modernization.

This guide, *Modernizing Data Systems in Environmental Public Health: A Blueprint for Action*, was created to address that need. It serves as a practical and strategic resource for EPH professionals who seek to enhance their data understanding, capabilities, and data infrastructure. Organized by thematic sections, the guide provides foundational principles, actionable strategies, real-world case studies, and tools to support jurisdictions of all sizes and capacities to make significant progress toward modern, resilient data systems.

Portions of this document and the associated checklist were developed with assistance from ChatGPT (GPT-4, OpenAI, accessed on August 2025). The artificial intelligence (AI) tool was used to reword and edit content for grammar, flow, and clarity; generate illustrative EPH examples; and support the development of final checklist items based on the content of this guide. All AI-assisted material was reviewed, verified, and revised by the authors to ensure accuracy, clarity, and alignment with the standards and mission of NEHA.

NEHA extends its deepest thanks to the authors, contributors, reviewers, and partners who brought this guide to fruition. This resource is meant to not only inform but also empower EPH leaders and practitioners with the knowledge, inspiration, and tools necessary to advance data modernization and improve the health of the communities they serve.

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Section 1: Introduction to Data Modernization and Environmental Health Informatics

The Case for Data Modernization

Environmental public health (EPH) agencies play a vital role in protecting communities from preventable harm. EPH is essential to safeguarding the well-being of every community. From ensuring safe food, water, and waste systems to preventing vector-borne diseases and managing hazardous materials, environmental health protects lives and sustains the environments we depend on. To achieve this protection effectively, the work of EPH agencies depends on collected and utilized data. Data are more than just a record of past actions and serve as a resource that informs decision-making, guides resource allocation, supports transparent communication, and promotes continuous improvement.

Data modernization involves transforming how public health systems gather, handle, analyze, and share data. For EPH programs, it replaces traditional methods like paper workflows, spreadsheets, and isolated databases with advanced systems that support real-time decisions, community involvement, and collaboration across agencies. This shift signifies a change in mindset and operations, viewing data as not only an administrative chore but also a vital element of effective public health efforts.

To demonstrate how data serves as a continuous driver of improvement, the data management lifecycle depicted in Figure 1 illustrates the full arc of data use, from initial surveillance and community input to analysis, insight, action, and re-evaluation. This cycle highlights the interconnected steps that transform raw data into meaningful, actionable information to support informed and responsive decision-making in environmental health.

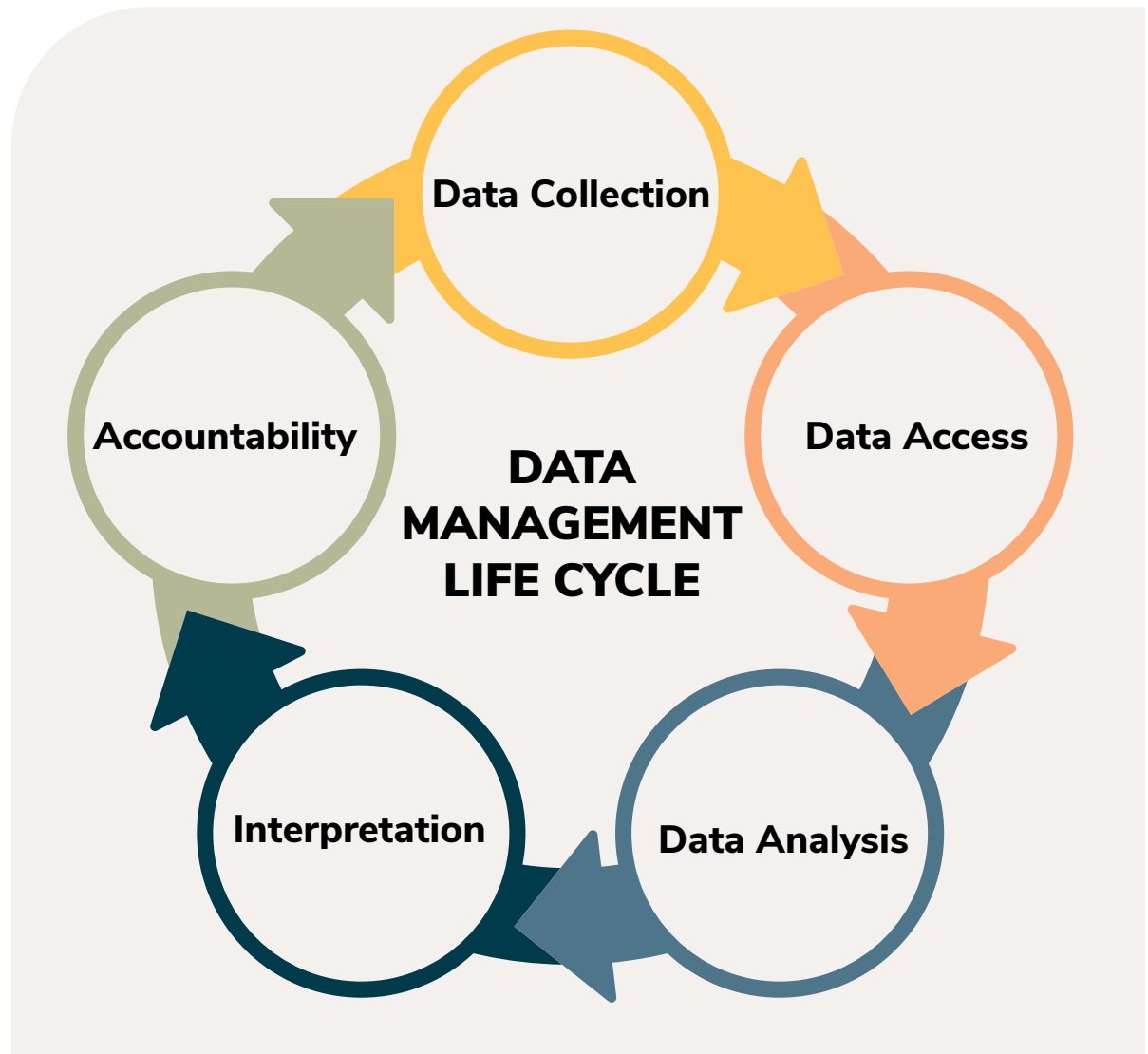


Figure 1

Strategic Role of Data Modernization in Environmental Health

Environmental health informatics sits at the intersection of environmental health practice, information systems, and data analytics. When agencies modernize their data systems, they unlock the ability to detect environmental exposures sooner, analyze risks more effectively, and deploy interventions more strategically. They also gain tools to strengthen partnerships with community organizations, emergency response teams, and other public health units. Modern informatics capabilities enable predictive modeling, automated reporting, geospatial analysis, and public-facing dashboards that promote transparency and trust.

Modernized environmental health data systems contribute to public health resilience in the face of current and emerging threats. From the impacts of climate change to the spread of new contaminants and diseases, today's environmental challenges require agile and data-driven responses. Real-time access to high-quality data supports efforts ranging from heat emergency response coordination to flood zone inspection reroutes and outbreak source tracing. In this context, modernization is not a luxury, it is a public health necessity.



Core Principles to Guide Data Modernization

As a general practice, modernization efforts are guided by several core principles to enhance their effectiveness (Table 1). These principles form the basis for planning, implementation, and ongoing improvement. They ensure that modernization not only introduces new technologies but also enhances the overall functionality, fairness, and impact of data on EPH services. When applied consistently, these principles enable agencies to protect public health better, respond to emerging threats, and serve communities with transparency and efficiency. Each of these principles will be explored in more detail in later sections of this guide, which will provide practical examples and actionable steps for implementation.

Table 1

CORE PRINCIPLE	DESCRIPTION
Timeliness	Data reflect current conditions to inform proactive enforcement, guide emergency response, and support real-time decision-making.
Standardization	Shared definitions, formats, and data dictionaries promote consistency, reduce errors, ensure reliability and validity, and support comparisons across programs.
Accessibility	Data are intended to be accessible to analysts, field staff, administrators, and the public through user-friendly dashboards, mobile access, and direct query interfaces that allow authorized users to access the underlying or raw data securely.
Interoperability	Systems are expected to integrate in ways to reduce duplication, improve data flow, enable data aggregation, and enhance overall quality.
Security and Ethics	Data are to be protected through privacy laws (e.g., the Health Insurance Portability and Accountability Act [HIPAA]) and ethical stewardship, especially for sensitive records such as complaints or inspections.

Modernization also elevates the role of data as a strategic asset in organizational strategy. In a modernized EPH agency, data serves multiple strategic and operational purposes--data are not just collected and stored, it is leveraged to inform decisions, drive performance, and communicate value. Table 2 shows the diverse functions data can serve in a modernized agency, demonstrating how areas ranging from operations and workforce management to public engagement and funding justification are supported by data.

Table 2

FUNCTION	PURPOSE
System of Record	Documents all past and ongoing activities to create a reliable institutional memory.
Performance Measurement	Tracks inspection rates, violations, turnaround times, and compliance outcomes to evaluate effectiveness.
Decision Support	Guides field prioritization, resource allocation, and policy development through evidence-based insights.
Communication	Enhances transparency for the public, informs leadership, and delivers operational insights for staff.
Analytical Lens	Identifies disparities in services, environmental exposures, and health outcomes across populations; supports emergency communication and program advocacy efforts.
Workforce Management	Helps supervisors balance workloads, assign inspections, and monitor team performance.
Storytelling	Uses dashboards, maps, and visual reports to highlight progress and advocate for continued investment.
Community Engagement	Enables residents to explore data and provide feedback through interactive tools.
Grant Justification	Strengthens funding proposals by documenting needs, gaps, and outcomes.

Barriers and Challenges to Data Modernization

While data modernization offers many advantages, it often encounters notable challenges. Agencies might face budget constraints, limited IT resources, fragmented systems, and regulations that have not kept pace with technology. These challenges can be further complicated by the varied regulatory environment across local and state EPH agencies, which can slow efforts toward standardization and interoperability.



In addition, varying levels of data literacy among environmental health field staff can make it harder to fully leverage new tools, even when they are available. Targeted training and workforce development help ensure that modernization leads to meaningful operational and public health improvements rather than remaining solely a technical upgrade. Leadership transitions, uncertainty around change, and competing short-term priorities can also slow progress—particularly in agencies without a clear, long-term modernization strategy.

Awareness of these barriers is essential for creating a realistic, phased approach that balances ambition with practicality. Successful strategies combine technology adoption with capacity building to ensure environmental health professionals are equipped with not only advanced tools but also the skills and confidence to use them effectively.

Ultimately, the goal of modernization is to create stronger, smarter, and more resilient environmental health systems. It aims to give EPH professionals the tools needed to protect communities efficiently, fairly, and transparently. Equally important, it seeks to re-center EPH within the larger public health system, making sure it is not sidelined by technological limitations but empowered by modern, mission-driven data systems that reflect the urgency and complexity of the work.

Section 2: Data Literacy and Foundational Skills

EPH data span multiple domains and disciplines, requiring professionals to be fluent in a diverse set of information sources. To thrive in a modern data environment, EPH professionals benefit from strong data literacy and foundational skills. These competencies enable practitioners to access, interpret, and effectively communicate data, ultimately improving public health outcomes and supporting informed, data-driven decision-making that benefits all communities.

Environmental Public Health Data Overview

EPH professionals benefit from familiarity with the following key types of data—each serving a distinct purpose, yet often interconnected: exposure data, health outcome data, surveillance data, demographic and socioeconomic data, geospatial data, regulatory and compliance data, and financial and budgetary data. Communication records data are a cross-cutting element that support and enhance all these categories by linking technical findings to the outreach, notifications, and engagement activities that give them real-world context and drive action.

Exposure data capture environmental measurements such as air quality, water contaminants, chemical exposures, and radiation levels. These indicators are essential to assess risk in residential and occupational settings.

Health outcome data include records of illnesses and conditions potentially linked to environmental factors, such as asthma, lead poisoning, heat-related illness, and certain cancers, which serve as a basis for epidemiological analysis.

Surveillance data are collected continuously to monitor trends and detect emerging public health threats. These data might include patterns in vector-borne diseases, foodborne illness outbreaks, or violations of drinking water standards.

Demographic and socioeconomic data provide context by offering information on age, race, income, education, and housing. These data help assess community vulnerability and highlight disparities in exposure and health outcomes.



Geospatial data, often visualized using GIS, enable EPH professionals to map risks, identify spatial trends, and define service areas or inspection zones.

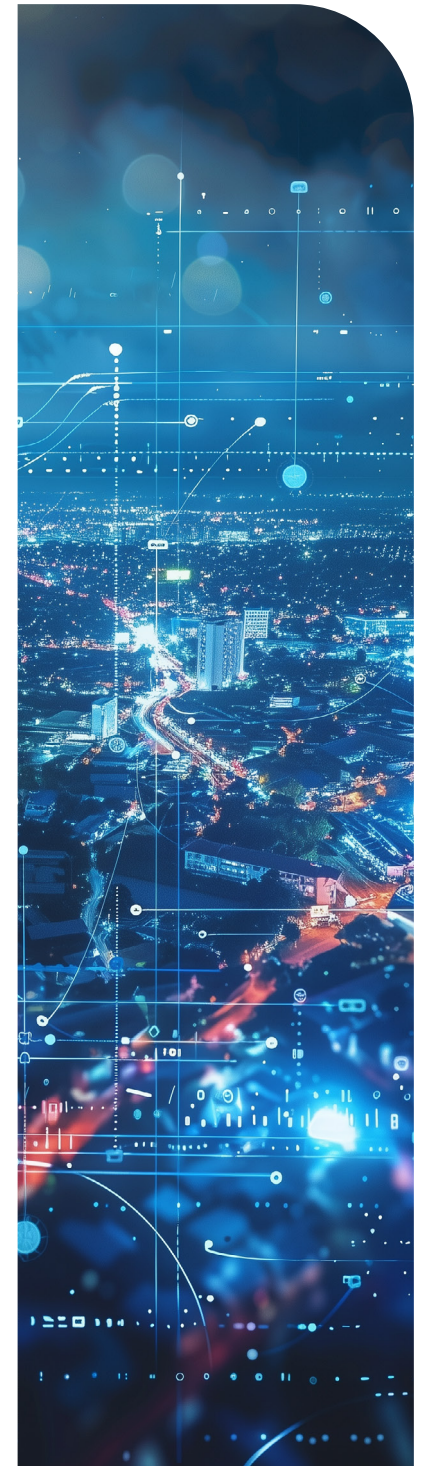
Regulatory and compliance data include documentation of inspections, permit statuses, violations, and enforcement actions. These records confirm adherence to EPH regulations, aid agencies in tracking program performance, and improve inspector deployment strategies.

Financial and budgetary data encompass permit and license fee payments, fines and penalties, and budget allocation and expenditure tracking, while also functioning as a public health surveillance and compliance tool that integrates with accounting systems to reconcile revenues and expenses.

Table 3 presents real-world examples of each type of data to illustrate how they are applied in practice and how they support core functions within environmental public health programs.

Table 3

TYPE OF DATA	DESCRIPTION	REAL-WORLD EXAMPLE
Exposure Data	Measurements of environmental conditions that pose potential health risks.	South Coast Air Quality Management District, California: Provides real-time air quality measurements and forecasts, including nitrogen dioxide and ozone levels for Southern California residents.
Health Outcome Data	Records of diseases or conditions linked to environmental factors.	New York City Department of Health: Publishes lead poisoning reports showing elevated blood lead levels in children by neighborhood.
Surveillance Data	Ongoing monitoring to detect patterns and threats.	Florida Department of Health's Arbovirus Surveillance: Tracks mosquito-borne diseases such as dengue and West Nile virus with weekly updates.
Demographic and Socioeconomic Data	Community-level statistics that inform health vulnerability.	University of Wisconsin's County Health Rankings: Aggregates data on income, education, housing, and access to care to assess community health drivers across U.S. counties.
Geospatial Data	Spatial information is used to analyze environmental and public health phenomena.	Mapping Inequality Project (a collaboration with universities): Uses historical redlining maps to study associations with current environmental exposures and health disparities.
Regulatory and Compliance Data	Documentation of environmental law enforcement and industry compliance.	Massachusetts Department of Environmental Protection: Posts public records of hazardous waste site inspections and enforcement actions against noncompliant facilities.
Financial and Budgetary Data	Financial and budgetary data, including fees, fines, and budget tracking, are integrated with public health surveillance and compliance systems.	A typical environmental public health department might integrate permitting and inspection systems with payment processing and budget tracking to align operational, financial, and compliance data.



Key Data Sources

EPH professionals operate in a complex and rapidly evolving landscape where accurate, timely, and contextually relevant data are essential for effective decision-making. No single source can provide the whole picture. To conduct strong analyses and take well-informed action, EPH professionals draw from multiple trusted sources to ensure thorough analyses and informed decision-making. The following is a sample of the key sources commonly used in EPH practice:

Federal Agencies: Centers for Disease Control and Prevention (CDC), U.S. Environmental Protection Agency (U.S. EPA), U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA).

State and Local Agencies: Health and environmental protection departments, urban planning divisions, and regional data portals.

Community-Based Sources: Grassroots monitoring efforts, participatory science projects, local nonprofits, and academic partnerships can provide valuable hyperlocal insights.

Internal Systems: Data collected directly from inspections, mobile apps, surveys, and permitting systems within an agency's own environmental health management system (EHMS).

Table 4 provides more detailed information and real-world examples of each source type and highlights how they contribute to effective EPH practice.

Table 4

SOURCE TYPE	SUBCATEGORY (IF APPLICABLE)	DESCRIPTION	REAL-WORLD EXAMPLES	KEY CONSIDERATIONS
Federal Agencies	-	National data and tools for tracking environmental conditions, health outcomes, and trends.	• CDC Environmental Public Health Tracking Network • U.S. EPA Envirofacts and ECHO • USGS Water Data • NOAA Climate Data Online	Broad coverage, scientifically validated; could lack local specificity or timeliness.
State and Local Agencies	-	Regional or city-level environmental health data tied to specific populations and geographies.	• California Environmental Health Tracking Program • Massachusetts Asthma Surveillance • NYC Environment & Health Data Portal	More localized and policy-relevant, quality and availability can vary by jurisdiction.
Community-Based Sources	Grassroots Monitoring	Informal resident-led data collection using low-cost tools.	• Air Louisville: Residents monitor pollution with smart inhalers.	Provides hyperlocal context; data could lack standardization or scientific rigor without oversight.
	Participatory Science Projects	Public volunteers assist in scientific data collection and analysis.	• CoCoRaHS (Community Cooperative Rain, Hail, and Snow Network): Tracks precipitation via volunteer observers. • iNaturalist: Biodiversity mapping through public submissions.	Expanding reach and community engagement requires training and quality control to be essential.

Table 4 (continued)

SOURCE TYPE	SUBCATEGORY (IF APPLICABLE)	DESCRIPTION	REAL-WORLD EXAMPLES	KEY CONSIDERATIONS
Community-Based Sources	Local Nonprofits and Non-governmental Organizations	Community organizations that conduct studies or advocacy tied to health and the environment.	GreenRoots (Massachusetts): Heat and flooding risk mapping.	Trusted in local contexts; often issue-driven, with deep community ties but limited scalability.
	Academic-Community Partnerships	Collaborations between universities and local communities to co-produce data and research.	Flint Water Study: Exposed lead via resident sampling.	High research quality; dependent on funding cycles and time-limited studies.
	Hyperlocal Surveys and Reports	Community-driven assessments using interviews, focus groups, or neighborhood audits.	Boston Chinatown Heat Study: Tracked temperature variation with handheld sensors and resident input.	Rich qualitative insight; requires strong community trust and labor-intensive data collection.
Internal Systems	-	Data from within an agency's operations—collected via inspections, apps, permitting, and surveys.	- Mobile food safety inspections - Environmental health management system dashboards - Public complaints and heat-related illness reports	Directly actionable and operationally relevant; accessibility depends on data infrastructure and staff training



Data Quality and the Role of Metadata

Data Quality

Reliable data are essential for credible environmental health efforts. Since agencies rely on various sources, data quality is crucial for effective analysis and decision-making. Inaccurate data, be it incomplete, outdated, or inconsistent, can lead to false conclusions and missed opportunities for action. Therefore, the goal is for data to be accurate, complete, consistent, and timely.

EPH professionals can evaluate datasets using four key dimensions: 1) accuracy, 2) completeness, 3) consistency, and 4) timeliness. These criteria help determine if data can be trusted to inform programs, policies, and public communications.

Table 5 provides examples to illustrate how each data quality dimension plays out in practice.

Table 5

DATA QUALITY DIMENSION	DEFINITION	EXAMPLE
Accuracy	Does the data accurately reflect real-world conditions?	A health department installs calibrated air monitors near a school. If the sensor reads 35 $\mu\text{g}/\text{m}^3$ on a visibly clear day, it could be an inaccurate reading. Investigating sensor drift ensures valid results.
Completeness	Are there missing fields or gaps that could distort the analysis?	Missing GPS data in inspection records prevents mapping violation hotspots, limiting enforcement strategies.
Consistency	Are data collection methods and definitions uniform across time and systems?	One hospital codes asthma emergency department visits as “respiratory illness,” while others use ICD-10. Inconsistent coding makes state-level comparisons unreliable.
Timeliness	Are the data recent enough to support timely decisions?	Using 2019 census data for 2025 can lead to screening misses of recent demographic shifts, potentially overlooking high-risk populations.



Metadata

Equally important as the data itself is the presence of metadata, the descriptive information that explains how the data was collected, its source, limitations, structure, and update frequency. Metadata allow analysts to understand the context and make informed decisions about appropriate uses of the data. Comprehensive metadata support data transparency, accuracy, interoperability, and reusability, enabling EPH professionals to use and share data confidently.

Metadata are often described as “data about data.” It provides critical details about the origin, content, format, and evolution of a dataset. Well-documented metadata helps users to understand what the data represents, how the data was created, its current relevance, and how the data should or should not be used. Different types of metadata serve various purposes:

Descriptive metadata identify and summarize the dataset, which includes elements such as the dataset title, a summary, and relevant tags that help users understand the general content and context.

Structural metadata explain how the data are organized. This includes details such as field names, data types, file formats, and the overall layout of the dataset, making it easier to navigate and interpret.

Administrative metadata provide information about the creation, ownership, and access rights of the dataset. Examples include the author’s name, version history, and any applicable licenses or usage permissions.

Provenance metadata document the origin and history of the dataset. It describes how the data were collected, processed, or transformed, such as data cleaning steps or quality control checks that were performed.

Statistical metadata outline the methods used during data collection or analysis, which might involve sampling strategies, aggregation techniques, or any statistical procedures that influence how the data can be interpreted.

Table 6 provides a simple example of metadata for an EPH dataset.

Table 6

METADATA FIELD	EXAMPLE
Dataset Title	2022 Food Safety Inspections: County A
Description	All restaurant inspection results in County A for 2022
Collected By	County A Environmental Health
Date Range	January 1, 2022–December 31, 2022
Last Updated	February 15, 2023
Format	CSV
Variables	Facility_ID, Inspection_Score, Violation_Code, Date
Confidential?	No (public dataset)



Managing Data With Integrity, Privacy, and Compliance

Responsible data use is crucial for maintaining public trust and ensuring environmental health initiatives are both effective and ethical. As data systems grow more sophisticated, it is important to maintain clear standards for privacy, fairness, and transparency throughout data collection and analysis. Responsible data stewardship is more than a legal requirement—it demonstrates respect for the communities involved. Ethical and thoughtful data practices enhance decision-making, strengthen relationships, and produce more reliable results in environmental health efforts. This stewardship includes:

Privacy protection involves compliance with laws and policies that govern the handling of personally identifiable information, protected health information, and informed consent. These safeguards ensure that sensitive data are used responsibly and ethically.

Fair representation means taking deliberate steps to avoid reinforcing inequities through data practices. Disaggregating data by race, geography, or income (e.g., analyzing heat illness rates by ZIP Code and income level) can surface hidden patterns and ensure that no population is overlooked in planning or response.

Transparency is achieved by open communication about how data are collected, used, and shared. This openness builds community trust and strengthens public engagement by showing that data are used not only effectively but also responsibly.

The Importance of Data Standards

Data standards serve as fundamental frameworks that establish how information is gathered, structured, classified, and shared. They operate as a universal language to enable EPH professionals from diverse organizations and regions to understand and utilize data with consistency and precision.

Just as standardized measurements such as inches, cups, or degrees facilitate clear communication about physical quantities, data standards reduce confusion in complex public health issues. When a local health department documents a major violation or reports a foodborne outbreak, standardized definitions ensure that colleagues elsewhere understand precisely what these terms mean, eliminating uncertainty and preventing misinterpretation.

What Happens Without Standards

When jurisdictions lack shared data standards, collaboration becomes difficult and analysis less reliable. For example, one county might classify restaurant violations numerically (e.g., 1, 2, 3) while its neighbor uses qualitative terms (e.g., minor, major, critical). Similarly, public health surveillance varies. One state might track only lab-confirmed cases of foodborne illness, while another might include probable or suspected cases. These differences make it hard to compare data or coordinate regionally.

What Happens With Standards

Shared standards streamline environmental health work across jurisdictions. Clear definitions allow key terms to be interpreted consistently. Structured data formats enable databases and systems to exchange information automatically. The use of a common vocabulary ensures comparisons are meaningful and reporting is accurate. Most importantly, interoperable systems foster seamless data sharing, whether during day-to-day operations or public health emergencies.

Key Standards That Support Modern Environmental Health Systems

Standardization is crucial to ensure that data remain interoperable, reusable, and meaningful across platforms. Consistent formats, definitions, and structures allow environmental health data to be easily shared, understood, and applied across systems and organizations. These standards facilitate interoperability—the ability of different tools and platforms to exchange and utilize data without errors or miscommunication.

Reusable indicates that data can be employed multiple times for various purposes, such as analysis, reporting, or community engagement, without needing to be restructured or reinterpreted. Alignment with established standards enhances collaboration across departments and jurisdictions while simplifying integration with national systems, ultimately strengthening the effectiveness and reach of EPH programs. Relevant frameworks and coding systems that support these standardization goals are important for EPH professionals to understand, including:

HL7 (Health Level Seven) is an international standard for health-related data exchange, commonly used in electronic health records, laboratory reporting, and disease surveillance.

LOINC (Logical Observation Identifiers Names and Codes) is a universal standard for identifying health measurements, observations, and documents. It is primarily used to code laboratory tests and clinical observations.

ISO (International Organization for Standardization) provides internationally recognized frameworks to ensure quality, consistency, and interoperability across various domains. In environmental health, ISO standards are commonly used for:

- **Environmental management** (e.g., ISO 14001): To help organizations manage their environmental responsibilities systematically.
- **GIS** (e.g., ISO 19115): To standardize how spatial data are collected, stored, and shared.
- **Metadata** (e.g., ISO 19115, ISO 19139): To ensure that descriptive information about datasets is structured and interoperable across systems.

Visualization and Communication

The ability to effectively communicate complex data is just as important as analyzing it. Visualization tools, ranging from charts and dashboards to GIS maps and infographics, help bring data to life, revealing patterns, trends, and priorities that might otherwise go unnoticed. Proficiency in the following areas is valuable for EPH professionals:

Creation of intuitive visualizations using clear charts, tables, graphs, and infographics that highlight key messages.

Development of GIS maps to visualize spatial relationships, risk concentrations, and service gaps.

Design of dashboards that support real-time monitoring and communicate program performance to interested parties and partners.

Translation of complex findings into actionable insights that resonate with non-technical audiences, including agency leaders, policymakers, and community members.

Strong communication through data visualization helps drive action, inform policy, and secure buy-in from leadership and community members.

Improved data literacy and foundational skills equip EPH professionals to navigate modern systems, interpret complex datasets, and use data as tools for prevention, engagement, and impact. These competencies are not optional in the era of modernization and are essential for building healthier, more informed, and more resilient communities.



Section 3: Core Principles of Data Modernization

Modernizing environmental health data systems involves more than technology and is a strategic process informed by a clear set of principles. These core principles ensure that modernization efforts are purposeful, sustainable, and capable of delivering value to public health professionals and the communities they serve. A well-structured modernization strategy can enhance service accessibility, improve operational efficiency, and strengthen long-term resilience through effective data management practices.

The FAIR Principles for Optimal Data Use

A foundational framework for data modernization is the FAIR principles—findable, accessible, interoperable, and reusable. Initially introduced in 2016 in *Scientific Data* to guide scientific data stewardship, these principles serve as a global standard for making digital resources more valuable and meaningful across different systems and users. In EPH, these principles help ensure data can be used across jurisdictions, are accessible, and apply in both routine operations and emergency response. Table 7 illustrates how each component of the FAIR framework is applied in EPH, with practical examples and real-world use cases to support its implementation.

The FAIR framework improves not only internal data management but also external transparency, making environmental health data more discoverable, shareable, and impactful.

Table 7

FAIR PRINCIPLE	DEFINITION	GENERAL EXAMPLE	USE CASE
Findable	Ideally, data are easily located and understood by humans and machines, which includes metadata, standardized tagging, and centralized access points.	A state public health agency creates a searchable online map showing neighborhood-level health burdens (e.g., pollution, asthma rates), supported by indicator definitions and metadata.	Local community organizations use the tool to find data for grant applications and environmental justice efforts.
Accessible	Systems allow secure but user-friendly access to data, including explicit permissions, documentation, and compatibility with assistive technology.	A city government offers an open data portal with downloadable datasets on air quality complaints, dumping incidents, and water quality—accompanied by plain-language user guides.	Neighborhood coalitions and journalists access these data to track local environmental trends and advocate for policy changes.
Interoperable	Data integrates smoothly across systems, agencies, and tools through standardized formats, vocabularies, and APIs (application programming interfaces).	A regional health department publishes lead and PM2.5 data in standard geospatial formats via an API, enabling other entities to overlay with housing or hospital data.	Urban planners and researchers combine datasets to identify neighborhoods needing infrastructure upgrades or public health interventions.
Reusable	Datasets are well-documented with metadata, methods, and licensing so they can be reused in multiple contexts.	A university-led air monitoring project releases datasets with complete documentation (e.g., sensor calibration, collection dates, reuse terms).	Advocacy groups and educators repurpose the data in public forums, policy briefs, and student projects to raise awareness.

Timeliness and Real-Time Access

Environmental health decisions are often time-sensitive, particularly during outbreaks, natural disasters, or environmental emergencies. Real-time data availability enables agencies to deploy inspections, enforce regulations, and inform the public with greater speed and precision. Modernization efforts prioritize the following:

Infrastructure that supports live data streaming from mobile inspections, sensors, or external data feeds

Dashboards that update in near real-time can provide operational leaders with actionable information

Automated alerts or thresholds allow staff to respond quickly to risks without manual data review

Timeliness ensures that data remain relevant and recognizes that late data could have limited value in prevention or threat containment.

Role of Consistency

While formal standards provide the foundation for data interoperability, equally important is the consistent application of those standards across programs, systems, and time. Standardization provides the foundation for data interoperability, aligning formats, definitions, and coding schemes across environmental health systems. It is the consistent application of those standards across programs, departments, and time, however, that truly unlocks their value. Even the best-established frameworks lose their effectiveness if data entry practices, definitions, or naming conventions vary within or between agencies.

Why Consistency Matters

Consistent data ensure that the same metrics mean the same thing across programs and over time, making it possible to reliably compare information from one year, site, agency/organization, or jurisdiction to the next. It enables analyses, dashboards, and reports to draw from aligned, dependable inputs, thereby avoiding duplicated efforts, contradictory results, and misleading trends.

For example, one program might adopt standardized disease codes. Still, if a second program labels asthma-related visits under a general respiratory illness category, the data cannot be easily reconciled. Similarly, inconsistently recording geographic information, using a ZIP Code in one dataset and coordinates in another, can hamper spatial analyses, even when both methods adhere to an accepted standard.

Consistency in Practice

Proper consistency goes beyond selecting the right standards. It means establishing internal protocols for naming conventions, data entry practices, field definitions, and regular quality checks. These practices help maintain coherence across datasets, enabling EPH professionals to draw confident, evidence-based conclusions and share insights seamlessly with teams and external partners.

In short, if standards are the blueprint, consistency brings that blueprint to life, ensuring environmental health data are not only structured but also trustworthy, usable, and impactful across the agency and the communities it serves.

Accessibility and Usability

Data systems are designed with end users in mind. This consideration includes not only analysts and epidemiologists but also program managers, inspectors, community partners, and policymakers. An effective system translates complex data into usable insights. When systems are straightforward to navigate, they help staff work more efficiently, support better decision-making, and strengthen the connection between agencies and the communities they serve. The following design considerations help ensure that systems are user-centered, functional, inclusive, and practical for everyday use. Key features that enhance accessibility and usability include:

User-friendly interfaces that prioritize clarity over complexity in portals, dashboards, and mobile applications.

Tiered access controls that assign appropriate levels of visibility to staff, leadership, and the public, protecting sensitive information while ensuring relevance.

Language and design considerations to ensure that content is understandable and usable by people of varying backgrounds, literacy levels, and abilities, not just technically accessible.

Mobile functionality that supports field-based data entry, offline capabilities, and device compatibility for use during inspections, emergencies, or outreach events.

Training and help resources, such as onboarding materials, how-to guides, and ongoing technical support, are provided to empower all users, regardless of experience, to navigate and effectively apply system features.

Governance and Security

Data governance provides the policies, standards, and oversight needed to manage information ethically and effectively. Without strong governance, even the most advanced systems can falter due to confusion over data ownership, stewardship, or use. Clear governance practices ensure that data are protected, used appropriately, and aligned with agency goals and legal requirements.

Governance responsibilities vary based on the size and structure of the EPH agency or department. In larger agencies, such as state health departments, governance is typically handled by dedicated teams that might include chief data officers, data stewards, privacy officers, and IT security leads. These organizations often have formal data governance boards or committees to ensure coordination and policy alignment across programs.

In mid-sized local health departments, governance might fall to an IT or data manager, with responsibilities shared between program leads who oversee data collection and central staff managing access and security. In smaller or rural departments, program managers or directors often oversee governance informally, sometimes with support from general IT personnel or state-provided platforms that include built-in compliance tools.

Regardless of the structure, all agencies benefit from a clear framework for data stewardship, consistent access controls, and the ethical use of data. Key components of sound governance include:

Clearly defined roles and responsibilities for data collection, maintenance, access, and quality assurance

Regular audits and reviews to evaluate data accuracy, integrity, and usage

Security protocols such as encryption, multifactor authentication, and tiered permissions

Compliance with legal frameworks, including HIPAA, public records laws, and relevant state-level privacy statutes

Change management processes to guide and support system modifications over the lifetime of system use, ensuring continuity, user adoption, and alignment with evolving needs

A Data-Centric Culture

Technology alone cannot modernize EPH. Agencies are encouraged to support a workforce that understands and values data. This process requires a cultural shift toward data-informed thinking, backed by investments in professional development, cross-training, and the capacity to connect data to real-world impact through data-centered storytelling and policy analysis.

Continuous training ensures staff at all levels receive regular, role-specific instruction on data systems, analytics tools, and visualization techniques. This training builds foundational skills and confidence in using modern tools. Effective training equips staff to translate analytical findings into persuasive narratives and policy recommendations, supporting accuracy and impact in decision-making and action.

Internal champions play a crucial role in bridging the gap between technical and programmatic work. Identification and support of data champions within each team allow agencies to foster peer learning and encourage sustained engagement with data. These champions can model how to frame technical findings into stories that resonate with decision-makers and communities, and how to align data insights with regulatory and policy priorities.

Celebration of success helps reinforce a culture of data use. The sharing of data-driven improvement stories, whether in compliance rates, community engagement, or resource allocation, not only demonstrates the practical value of modernization but also builds morale and broader buy-in across teams.

A strong data culture fosters innovation, enhances morale, and empowers staff to adapt to emerging technologies confidently. When data modernization efforts are anchored in these core principles—FAIR data practices, real-time access, standardization, usability, governance, workforce readiness, data-centered storytelling, and policy analysis—EPH agencies can ensure their investments lead to more responsive, equitable, and sustainable public health systems. These principles provide the scaffolding on which agencies can build sound data infrastructures that are prepared for not only today's needs but also tomorrow's uncertainties.

Section 4: Essential Tools and Technologies for Data Modernization

In the era of data modernization, the goal is for EPH departments to adapt and expand their ecosystem of digital tools to collect, manage, analyze, and act on data. These technologies not only enhance operational efficiency but also empower professionals to make faster, more accurate, and more accessible decisions that improve public health outcomes. This section provides an overview of key tools used throughout the data lifecycle.

While the examples provided below represent commonly used platforms, they are not exhaustive. Many other tools and technologies are equally valuable, and selection should be based on agency needs, capacity, and integration goals. Inclusion in this guide does not imply any endorsement by NEHA of these products, services, or resources.

Foundational Technology Needs in Environmental Health

Modern EPH operations require strong infrastructure to support field activities, back-office systems, regulatory enforcement, and public communication. Four core technology categories form the foundation of this digital ecosystem:

Centralized Data Storage and Infrastructure

EPH programs generate large volumes of structured data, including inspection reports, permit records, sampling results, and complaint histories. Secure and scalable data systems allow agencies to manage these records in a centralized location. Many of these systems include role-based access controls, audit trails, and integration with analytics or GIS platforms. Increasingly, agencies also use cloud-based servers to facilitate real-time syncing, backup, and remote access.

Public-Facing Platforms for Transparency and Engagement

Effective data modernization involves not only internal tools but also systems that promote transparency and support service delivery to the public. For example, Accela's Citizens Access Portal allows residents to search for permits, submit complaints, or request inspections online. Some jurisdictions also use in-office kiosks such as ALICE (automated local information center for the environment), which enable walk-in customers to pay fees or access services without staff assistance.

Fieldwork and Mobile Integration

Because much of EPH work takes place in the field, agencies need tools that enable real-time data collection and upload. Digital tools and platforms support tablet-based inspection entry, photo capture, digital signatures, and offline syncing. In specific contexts, inspections can be performed remotely via video call, especially in lower-risk situations where staff efficiency or geographic limitations are a concern.

Emergency Response and Crisis Coordination

In the event of environmental hazards, disease outbreaks, or natural disasters, EPH departments need to respond quickly. Modern systems allow agencies to rapidly assess damage, log facility impacts, and coordinate enforcement activities. Integration with GIS, survey tools, and field apps makes it possible to deploy resources in real time, map affected areas, and track progress during response operations.



Geographic Information Systems (GIS)

In environmental health, GIS is a transformative technology that offers spatial visualization of hazards, inspections, populations, and environmental exposures. It supports crucial functions such as:

- Hotspot identification for foodborne illness or lead exposure
- Location mapping of vector breeding grounds
- Wildfire smoke, flood zone, and air quality monitoring
- Visualization of permit and inspection coverage by region
- Community planning based on onsite sewage management system inventories

GIS is foundational to modern environmental health practice. ArcGIS Pro, Esri's flagship desktop application, supports advanced spatial analysis, geodatabase management, and cartographic design. For cloud-based collaboration, ArcGIS Online allows users to share interactive maps and data, often paired with ArcGIS Dashboards for real-time tracking or Experience Builder for dynamic web applications that blend maps, statistics, and narrative context.

In addition to Esri's ecosystem, a variety of alternative GIS platforms can support EPH programs, especially those seeking low-cost, scalable, or specialized solutions. Table 8 highlights several commonly used platforms.

Table 8

TOOL	DESCRIPTION
ArcGIS Pro	Esri's flagship desktop application is used for advanced spatial analysis, geodatabase management, and cartographic design.
ArcGIS Online (AGOL)	Cloud-based platform for sharing maps and data, with companion apps for analysis, visualization, storytelling, and field collection.
QGIS	Free, open-source GIS solution that offers spatial analysis and mapping capabilities without licensing costs—ideal for resource-constrained agencies.
Mapbox	A developer-friendly platform is frequently used to create custom, web-embedded interactive maps.
Google Earth Engine	Cloud-based platform designed for large-scale remote sensing analysis using satellite data.
CARTO	Cloud-based GIS platform provides advanced mapping and analytics tools, suited for geospatial business intelligence applications.

GIS in Emergency Response

GIS plays a central role in emergency preparedness and coordination. In a wildfire or flood, agencies incorporate real-time data feeds on weather, fire perimeters, road closures, and power grid outages. This information helps staff prioritize inspections, issue advisories, or deploy response teams to critical areas. Apps like Survey123 and Workforce for ArcGIS are often used together to assign tasks and collect field data during response operations.

GIS and Remote Sensing

EPH agencies increasingly rely on imagery analysis to detect conditions that require intervention. For example, by using drone or satellite imagery in conjunction with deep learning models, staff can identify green pools and potential mosquito breeding sites across broad geographic areas. These insights guide vector control strategies and reduce reliance on complaint-driven systems.

GIS for Redistricting and Staffing

In large jurisdictions, equitable and efficient staff deployment requires thoughtful geographic planning. In San Bernardino County, California, for example, some inspectors may travel up to 4 hours to reach the edge of their assigned district. Every few years, the agency uses ArcGIS Pro to redraw district boundaries based on changes in staffing, population, and inspection volume. This redistricting process helps optimize travel time, workload balance, and response coverage. Staff turnover and vacancies might also necessitate dynamic reassignment of district responsibilities, a challenge that GIS helps visualize and solve.

Data Visualization Platforms

Data visualization tools transform complex datasets into clear, intuitive formats such as maps, dashboards, charts, infographics, flow diagrams, and graphs. These tools help EPH departments drive action, communicate results, and support evidence-based decision-making. Common uses include:

- Internal performance oversight
- Program reports to funders and leadership
- Public dashboards that promote transparency and accountability

EPH agencies can use a variety of visualization platforms depending on their needs, technical capacity, and audience. In addition to GIS-based solutions, platforms like Power BI, Tableau, ArcGIS Online, Smartsheet, Google, and other cloud-based platforms support interactive reporting, real-time metrics, and spatial storytelling. Table 9 outlines several commonly used platforms, their tools, and their typical use cases.



Table 9

PLATFORM	DESCRIPTION	TYPICAL USE CASES
Power BI	Integrates with Microsoft tools (e.g., Excel, SQL) and supports interactive and customizable reports or dashboards.	Internal dashboards and executive reporting
Tableau	Offers polished interactive dashboards and maps, visual storytelling, and an intuitive drag-and-drop interface.	Academic research, policy reports, and advanced data storytelling
Smartsheet	Simple, no-code dashboards for teams using Smartsheet, with minimal setup required.	Project tracking and basic status reporting
Google Looker Studio	Cloud-based, free platform for visualizing data from Google Sheets, BigQuery, and other sources.	Light visualizations for public-facing or internal needs
ArcGIS Online	A cloud-based platform in Esri's GIS ecosystem that hosts apps like Dashboards and Experience Builder to combine maps with data for real-time tracking and spatial analysis.	Spatial dashboards and interactive mapping apps

Data Processing and Analysis Tools

Data frequently requires transformation, cleaning, and analysis before they can be used for decision-making or reporting. This process, known as extract, transform, load (ETL), is essential to making raw information usable and reliable. ETL is a data processing workflow that transfers information from source systems to destination systems while preparing it for analysis. It includes:

Extract: Data are pulled from sources such as databases, spreadsheets, or application programming interfaces (APIs).

Transform: Data are cleaned and standardized, duplicates are removed, inconsistencies are corrected, rules are applied, and information is organized into usable formats.

Load: The processed data are placed into their destinations, such as dashboards, databases, or cloud warehouses.

In EPH, an ETL workflow might extract inspection data from an EHMS, transform the data by standardizing violation codes and dates, and load the data into a dashboard for field staff or community reporting. Automating these steps minimizes manual data entry, reduces errors, and allows for faster, more consistent analysis.

Python is especially valuable for automating ETL workflows. It is widely used in EPH to script repeatable processes for data cleaning, validation, and transformation. Python's extensive ecosystem of libraries—including pandas for tabular data, geopandas for spatial operations, and Arcpy for GIS automation—enables teams to integrate and prepare data at scale. Python allows agencies to streamline routine data preparation tasks and dedicate more time to analysis and decision-making.

EPH professionals use a variety of tools to perform ETL operations (Table 10). These tools are often used in concert: data might be queried with SQL, transformed in Python, and then visualized in Power BI, Tableau, or published to ArcGIS Online. The development of cross-functional fluency in these tools is essential for modern environmental health teams.

Table 10

PLATFORM	DESCRIPTION	BEST USES
Python	Open-source programming language ideal for automation, analysis, and integration with APIs. Standard libraries include pandas, geopandas, and Arcpy.	Automated workflows, spatial analysis, and custom data processing
SQL	Standard language for querying relational databases. Allows precise extraction and organization of structured records.	Database queries, reporting pathways, and data integration
Excel	Widely used spreadsheet tool for entry-level analysis, formulas, pivot tables, and charting.	Quick data exploration, basic reporting, and formatting tasks
R	Statistical programming language used heavily in epidemiology and research. Offers powerful modeling and visualization capabilities.	Advanced analytics, public health research, and data modeling
SAS	Commercial suite for analytics, modeling, and secure data handling. Often used in large public health agencies.	Institutional analytics, regulatory reporting, and secure datasets

Mobile Data Collection and Field Tools

In field-based workflows, mobile tools are indispensable for real-time data capture and submission. They lower error rates, remove paper-based processes, and speed up reporting, resulting in more accurate, efficient, and responsive EPH programs. Table 11 includes commonly used platforms.

Table 11

TOOL	DESCRIPTION	BEST USES
Survey123	A form-based app integrated with ArcGIS Online. Supports conditional logic, offline mode, and photo capture.	Field surveys, complaint forms, and inspections
Field Maps	Combines mapping, data collection, and navigation in one mobile app. Offers seamless integration with ArcGIS layers.	Field inspections, asset tracking, and spatial data collection
Workforce for ArcGIS	A task management and dispatching app for organizing field assignments. Enables tracking of task progress and field team coordination.	Scheduling inspections and emergency response coordination
Fulcrum, KoboToolbox, EpiCollect	Low-cost or open-source alternatives with customizable forms, geotagging, and offline capabilities.	Agencies with limited budgets or non-Esri platforms

Since EPH staff frequently operate in rural or underdeveloped regions with limited connectivity, mobile systems need offline data collection and synchronization features. These features allow field personnel to collect data without service access and upload it smoothly when a connection is restored. To fully leverage mobile technology in field operations, EPH programs can ensure that mobile tools are:

Offline-capable: Support data capture without connectivity, with smooth synchronization when service is restored.

User-friendly: Provide intuitive, quick data entry to minimize training needs.

Secure: Incorporate encryption, authentication, and access controls to protect sensitive information.

Integrated: Connect directly to core environmental health data platforms to reduce duplicate entry and enable real-time updates.

Configurable: Allow customization for specific program forms, workflows, and regulatory standards.

Reliable: Function consistently in diverse field conditions, including severe weather or low light.



Artificial Intelligence

Artificial intelligence (AI) technologies are transforming how EPH departments manage data, making it faster, easier, and more effective to extract insights and act on information. Although still emerging in many areas, AI tools are increasingly used to automate routine tasks, uncover hidden patterns, and support more informed decision-making. AI is a complement, not a substitute, for expert judgment. It enhances decision-making by augmenting capacity, automating routine tasks, and uncovering trends that might otherwise go unnoticed.

The modernization of EPH data systems relies on the strategic integration of tools across the whole data life-cycle. GIS helps visualize patterns and plan interventions. Visualization platforms translate data into insights. Processing tools support quality control and analysis. Mobile applications streamline fieldwork. AI adds new layers of insight and automation. Together, these technologies empower EPH professionals to work more effectively, respond more rapidly, and engage more meaningfully with the communities they serve.

As agencies continue to adopt and expand their use of these tools, the focus remains on usability, scalability, sustainability, and broad accessibility. A modern data environment is not only more efficient but also more capable of meeting the evolving challenges of EPH. Table 12 highlights practical examples of how AI is applied in EPH to streamline operations, enhance analysis, and improve community responsiveness.

Table 12

AI APPLICATION	USE CASE EXAMPLE
Custom language models trained in agency documents allows staff to ask natural language questions and instantly retrieve policy guidance.	A health department trains an internal chatbot on policy manuals. Inspectors can ask, “What’s the protocol for foodborne illness response?” and receive immediate guidance.
Automated report generation uses inspection data to generate summaries, violation lists, or follow-up notices.	After routine inspections, AI translates spoken inspection observations into rule citations, appropriate legal descriptions of the violation, and recommended corrective action for the inspector to validate and edit, thus reducing time on data entry and documentation, and increasing time for education.
Anomaly detection flags outliers or unusual trends in inspection or complaint data.	An AI tool scans daily complaints and flags an unexpected spike in mold reports from a specific apartment complex, prompting an early investigation.
Predictive modeling forecasts seasonal complaints, identifies vector hotspots, and assesses staffing needs.	A department uses mosquito trap data and weather trends to predict areas of likely West Nile virus activity, guiding proactive larvicide deployment.
Natural language processing (NLP) analyzes open-ended feedback and categorizes themes.	NLP analyzes a community heat survey and identifies patterns like “lack of shade,” “housing issues,” and “transportation barriers.”
Image classification analyzes aerial or drone imagery to detect environmental hazards.	AI scans drone footage of vacant lots and detects piles of tires or stagnant water, flagging potential mosquito breeding grounds and illegal dumping.
Automated translation tools translate forms or submissions to improve accessibility.	A Spanish-speaking resident uses a complaint form in Survey123. It is auto translated into English for staff, ensuring timely response and follow-up.

Section 5: Lessons From the Field—Case Studies and Strategic Insights

As EPH departments across the U.S. face increasingly complex public health challenges, the need for modern, agile data systems has become crucial. Data modernization integrates advanced tools, digital platforms, and enhanced infrastructure to enable agencies to manage information better, increase transparency, and improve their capacity to respond to environmental and public health threats. This section presents case studies from various jurisdictions that have successfully implemented data modernization initiatives in EPH. Each case study highlights real-world applications, outcomes, and lessons learned.

Table 13

JURISDICTION AND PROJECT	MAIN GOAL	KEY CHALLENGES	SOLUTIONS IMPLEMENTED	OUTCOMES AND BENEFITS	TRANSFERABLE LESSONS
California: Traffic Exposure Mapping	Replace the out-dated 2007 Traffic Tool with a modern, public-access platform for traffic exposure data	No single, consistent traffic dataset; data scattered across multiple Caltrans sources; interoperability issues	Harmonized two major Caltrans datasets; standardized road segments; interpolated missing values; calculated daily vehicle miles traveled (DVTM); built a responsive, cloud-based tool	Improved public and researcher access to traffic exposure data; supports health risk evaluation; enables equitable urban planning	Standardize datasets early; invest in sustainable, user-friendly tools; prioritize partner engagement
San Bernardino County, California: Environmental Health Services Modernization	Modernize inspection, permitting, and service tracking using GIS tools	Vast geography with poor connectivity; siloed, paper-based processes; workload imbalance	Mobile GIS apps with offline capability; automated data pipelines; balanced inspection zones; integrated EnvisionConnect with dashboards	Increased inspection efficiency; real-time tracking of key performance indicators (KPIs); over 20 operational and public dashboards; improved workload equity	Start small and iterate; refine tools with user feedback; build strong interdepartmental partnerships
Texas: SHARP Platform	Create a unified, cloud-native health data warehouse	Manual, time-consuming data extraction; disparate program-specific systems	Built Snowflake-based warehouse; automated ETL pipelines; integrated cross-program datasets; compatible with SAS, Tableau, Power BI, R Studio	Reduced manual work by approximately 35%; improved decision-making; supported predictive modeling; secure external researcher access	Automate ingestion to free staff time; standardize formats; integrate familiar analytics tools to encourage adoption
Tennessee: Source Water Assessment Modernization	Automate and standardize risk assessment for public drinking water systems	Outdated (>20 years) manual assessments; scattered data in inconsistent formats	Centralized spatial database; automated delineation, scoring, and reporting; resilient to missing data; incorporated cross-state sources	Faster, more consistent updates; improved risk identification; transparent public reporting	Uses standardized data models; leverages open-source tools; designs resilient workflows; fosters cross-agency collaboration.

California: Traffic Exposure Mapping

Implementation

California's Environmental Public Health Tracking Program, in partnership with the Public Health Institute and CDC's National Environmental Public Health Tracking Program, modernized its legacy Traffic Tool by developing an interactive, cloud-based web application. The new platform incorporates standardized traffic exposure data from Caltrans, including daily vehicle miles traveled (DVMT) and annual average daily traffic (AADT). This tool enables users, from researchers to community members, to search for any location in the state and visualize traffic data within customizable buffers. The design allows for public accessibility through a responsive interface.

Challenges and Solutions

The modernization effort confronted a familiar hurdle: California lacked a single, consistent source of traffic data. Replacing the retired 2007 Traffic Tool involved assembling a statewide dataset from multiple Caltrans sources—notably the Traffic Census AADT counts and the Highway Performance Management System AADT estimates—and ensuring that these disparate data sets could work together. To solve this problem, the program aligned and joined the two datasets, standardized road segments using Caltrans' functional classification scheme, and interpolated missing values. This process allowed them to calculate the DVMT for each segment by multiplying AADT estimates by segment length.

The result is a harmonized 2019 traffic volume road network that underpins the new Traffic Tool. The tool's public interface lets users query DVMT and AADT for any location in California and reflects the project's goal, highlighted by CDC as “building a standardized and sustainable statewide data set on vehicle traffic” accessible to the public, researchers, and environmental health services.

Outcomes and Benefits

The updated Traffic Tool has improved access to environmental exposure data and supports public health practitioners, researchers, and planners in evaluating traffic-related health risks such as asthma and cardiovascular conditions. It enables more equitable urban planning by identifying high-traffic, high-vulnerability areas.

Lessons Learned

Sustainable design and partnerships are key to success. Early investment in standardized data infrastructure and intuitive design significantly improved user engagement and long-term usability. California's experience demonstrates the value of updating legacy systems with flexible, user-centric solutions that align with evolving data needs.



San Bernardino County, California: Environmental Health Services Modernization

Implementation

San Bernardino County Department of Public Health adopted a GIS-based modernization strategy to support its Environmental Health Services Division. Tools like ArcGIS Field Maps, Survey123, Dashboards, and Workforce replaced paper-based systems and enabled real-time tracking of inspections, permitting, and field service delivery. The department integrated its legacy EnvisionConnect database with mobile tools to allow inspectors to upload data remotely and supervisors to view program status live through dashboards.

Challenges and Solutions

San Bernardino County faced logistical and technical challenges in modernizing the Environmental Health Services Division. As the largest county by area in the contiguous U.S., field staff often work in remote regions with poor connectivity and long travel distances. Operations were previously siloed and paper-based, limiting coordination and real-time tracking.

To overcome these barriers, the department adopted mobile GIS tools with offline capabilities, enabling inspectors to collect data in the field and sync it later. Automated data pathways fed inspection data directly into dashboards, improving accuracy and eliminating manual processes.

GIS was also used to create balanced inspection zones, distributing workload equitably based on geography and facility density. The team developed a suite of customized GIS applications across programs, such as food safety, vector control, and land use, supporting a unified, department-wide modernization effort.

Outcomes and Benefits

Modernization led to increased inspection efficiency, streamlined workflows and emergency responses, improved workload tracking, and better public outreach. The department scaled its use of dashboards to over 20 apps supporting internal operations and public transparency. Field staff now complete more inspections per day, while managers monitor key performance indicators (KPIs) such as inspection completion and complaint response times in real time.

Lessons Learned

Start small, and iteration is key. Interdepartmental partnerships and strong leadership drove the adoption of new technologies and the integration of systems. Modern technology adoption among staff improved as tools were refined with user feedback and linked directly to performance improvements. The county's approach has become a model for scalable, GIS-enabled environmental health modernization.



Texas: SHARP Platform

Implementation

The Texas Department of State Health Services implemented the State Health Analytics and Reporting Platform (SHARP)—a cloud-native health data warehouse using Snowflake and integrated with SAS Viya and Tableau—for agency-wide data consolidation. It serves as a central environment for accessing, visualizing, and analyzing datasets across surveillance, immunization, vital statistics, and EPH programs. SHARP enables internal staff to conduct SQL queries, build dashboards, and perform predictive modeling from a shared platform.

Challenges and Solutions

Texas's modernization effort tackled the burden of manual data extraction and disparate data sources. Before SHARP was introduced, staff spent large portions of their day manually pulling and processing data. Feedback from SHARP users noted that manual processes previously consumed approximately 40 % of staff time.



To solve this issue, Texas built SHARP as a unified, cloud-based data warehouse using Snowflake. Data pathways now extract health information from various program-specific systems, validate and cleanse the data, and load the data into Snowflake, where it can be accessed through SQL queries or familiar analytics tools. According to users, the new system has freed up approximately 35 % of manual data extraction time for other responsibilities.

The platform integrates data across programs (e.g., linking lab reports, case investigations, immunizations, providers, and vital statistics). It supports visualization and analytic tools such as SAS, Power BI, R Studio, and Tableau.

Outcomes and Benefits

Access to cross-program data has improved data-informed decision-making, and external researchers can securely query de-identified datasets. Through a single repository with standardized data and automated processing, SHARP reduces manual workload. It allows public health staff to focus on interpreting data, producing dashboards, reports, and maps, and making more timely decisions. The platform has become foundational for Texas's future data modernization efforts.

Lessons Learned

Texas's modernization experience demonstrates the value of automating data ingestion and standardizing formats to reduce manual processing and free up staff time. By consolidating disparate program data into a Snowflake-based warehouse, SHARP enables users to view relationships across laboratory reports, case investigations, immunizations, providers, and vital statistics. It supports familiar tools such as SAS, Power BI, R Studio, and Tableau to minimize training barriers and encourage adoption. This unified approach, combined with a multilevel security model that tightly controls access to sensitive health information, underscores the importance of automation, data standardization, user-centric design, and strong governance for public health data modernization.

Tennessee: Source Water Assessment Modernization

Implementation

The Tennessee Department of Environment and Conservation (TDEC), in partnership with U.S. Geological Survey, modernized its Source Water Assessment Program by creating Tennessee (TN) Department of Environment and Conservation Source Water Assessment Program (SWAP) methodology using Python (PyT). This GIS-based tool automates the process of evaluating potential risks to public drinking water systems. TDEC built a cloud-ready workflow that standardizes data from TDEC, U.S. EPA's Safe Drinking Water Information System (SDWIS), and other federal and state sources; automatically delineates assessment zones; inventories potential contaminant sources; computes susceptibility scores using environmental variables such as land use and slope; and generates uniform reports for every public water system in the state. Centralized databases and reproducible scripts ensure that new datasets can be incorporated easily and that reports remain consistent across more than 600 systems.



Challenges and Solutions

Tennessee's original assessments were over 20 years old, and updating them manually was time- and resource-intensive, especially for smaller systems. Much of the relevant data was scattered across different agencies in varying formats. To address this issue, TDEC and USGS created a centralized spatial database designed to handle missing or inaccurate data, and it is flexible enough to incorporate information from adjoining states. The automated workflow makes the process faster, more consistent, and easier to maintain over time.

Outcomes and Benefits

The modernized approach dramatically reduced the time it takes to update assessments while improving consistency and accuracy. State staff can now quickly identify high-risk areas and prioritize where to take protective action. The tool also helps ensure that communities receive precise and up-to-date information about their drinking water safety.

Lessons Learned

Cross-agency collaboration and learning from other jurisdictions can accelerate modernization. Standardized data models and opensource tools are crucial for scalable automation and for handling diverse datasets. A workflow designed to be resilient to missing data and to support cross-state assessment zones ensures accuracy and broad applicability. Lastly, delivering user-friendly, automated reports improves partner engagement and allows agencies to focus on protective measures rather than administrative tasks.

Synthesis and Key Insights From the Case Studies

The four case studies from California, San Bernardino County, Texas, and Tennessee show that environmental health data modernization is not a one-size-fits-all process, but rather a strategic alignment of technology, governance, and user-centered design tailored to local needs. Despite differences in scope and scale—from localized traffic exposure mapping to statewide data warehouse—common themes emerge:

- Integration of disparate data sources
- Automation and cloud-readiness
- GIS as a core enabler
- Public accessibility and transparency
- Risk identification

These themes played out differently across various jurisdictions, yet all shared common elements such as iterative development, strong partnerships, and sustained investment in scalable infrastructure adaptable to both urban and rural settings.

In California and Tennessee, modernization efforts started by standardizing data models, classification schemes, and formats. This approach reduced integration complexity and ensured long-term maintainability. California's harmonization of traffic datasets and Tennessee's standardized risk assessment workflows exemplify how establishing early consistency results in systems that are both scalable and replicable.

Automation significantly saved staff time by streamlining data ingestion, processing, and reporting. For example, Texas's SHARP platform and Tennessee's TN-SWAPyT reduced manual processing by over one third, allowing for quicker updates and more responsive responses to emerging health threats.

GIS technologies played a crucial role in improving internal efficiency and enhancing public transparency. San Bernardino County's mobile GIS inspection tools and California's interactive traffic exposure maps supported field operations, helped visualize complex data for decision-making, and facilitated clear communication with communities.



Modernized systems also thrived when integrated with familiar tools such as Tableau, SAS, and ArcGIS, combined with responsive, user-friendly interfaces. Iterative refinements based on direct user feedback, as seen in San Bernardino and California, ensured that technical improvements translated into tangible operational benefits.

Finally, cross-jurisdictional and cross-sector collaboration proved vital. Tennessee's partnership with USGS and California's alignment with CDC provided essential technical expertise, data access, and funding. These collaborations reduced barriers and accelerated implementation.

Section 6: Emerging Strategies and Technologies in Data Modernization

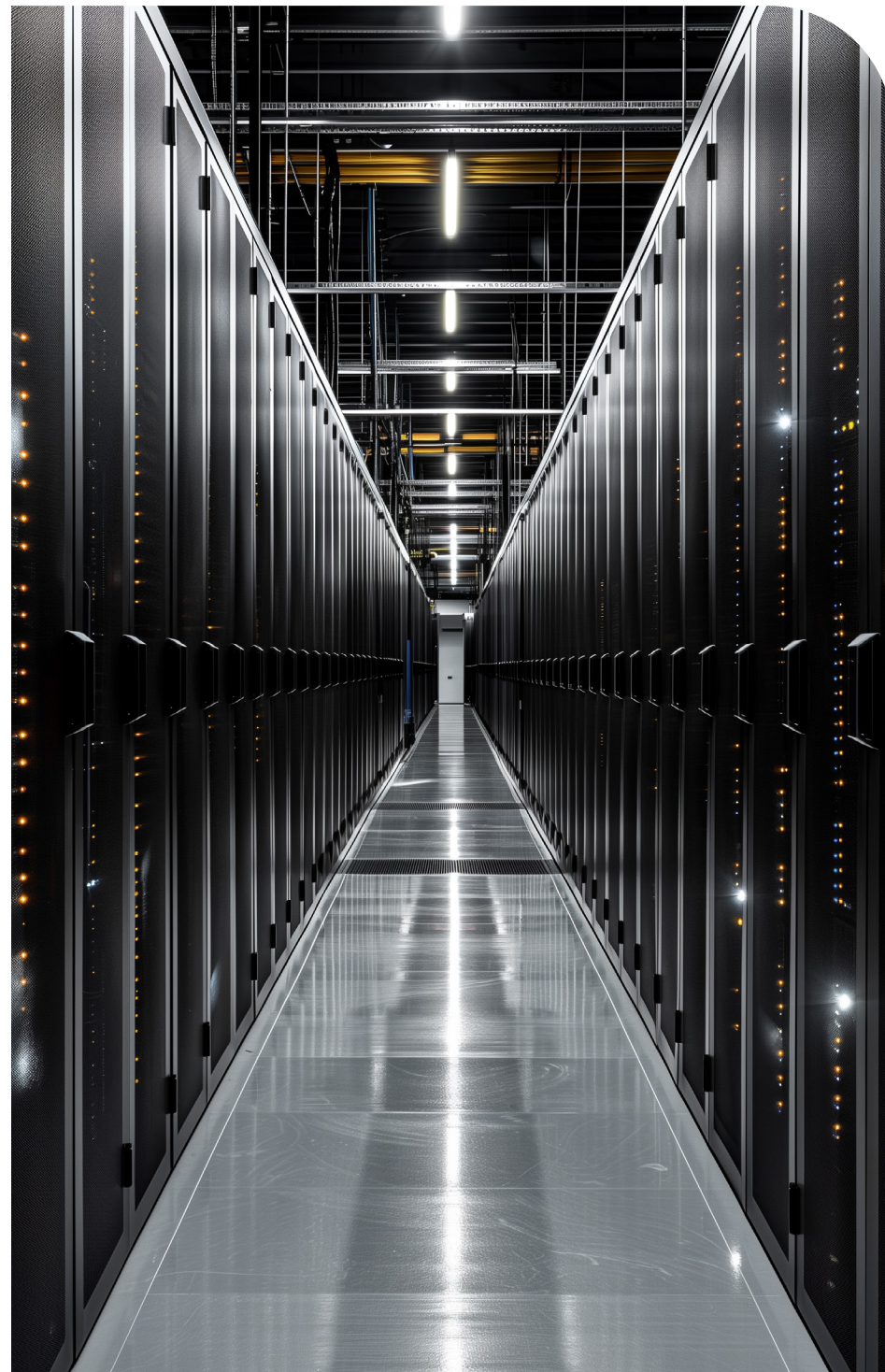
As expertise in data modernization grows, EPH professionals are well-positioned to address advanced topics that keep data practices secure, efficient, and strategically aligned with broader organizational goals. This section provides an overview of emerging technologies and advanced practices that represent the next frontier in environmental health data modernization. While these topics are beyond the scope of basic implementation, they offer significant opportunities for agencies that are ready to push the boundaries of what is possible with data-driven public health practice. This section is not intended as a comprehensive overview, but rather as a primer for exploration. EPH professionals and leaders interested in advancing their technical capabilities are encouraged to seek additional training, partnerships, and resources to deepen their understanding of these evolving areas.

Secure Organizational Artificial Intelligence

The deployment of AI within an organization's secure internal platforms enhances data analysis, predictive modeling, and process automation while maintaining strict data security standards. Hosting AI applications internally allows organizations to significantly reduce the risks associated with external data exposure and unauthorized access. Secure AI requires system integration within protected infrastructures, strict access controls, and regular security audits. Clear organizational policies, documentation of AI-driven decisions, and ongoing monitoring are essential to ensure transparency, ethical use, and bias mitigation. Staff training on the secure and appropriate use of internal AI tools is crucial for maximizing benefits and minimizing risks.

Example:

A city health department builds an internal AI tool trained on its food inspection records. Hosted on a secure local server, the system helps prioritize high-risk food establishments by analyzing past violations, neighborhood complaints, and inspection frequency, all while keeping sensitive data protected from external exposure.



Data and Cybersecurity: Protecting Information Assets

Data and cybersecurity involve a set of technologies, policies, and practices designed to protect digital data from unauthorized access, corruption, or theft. Effective data modernization necessitates cybersecurity measures to safeguard sensitive public health information. Comprehensive cybersecurity frameworks—incorporating multifactor authentication (MFA), encryption protocols, routine vulnerability assessments, and regular staff cybersecurity training—strengthen organizational security. A culture of cybersecurity vigilance ensures resilience against cyber threats, protects the integrity of public health data, and maintains community trust.

Example:

A state environmental health agency implements MFA and role-based access controls for its complaint database, ensuring that only authorized staff can access resident-submitted health data. Annual phishing simulations and cybersecurity training sessions also enhance the system's integrity.

Cloud Computing: Infrastructure for Modernization

Cloud computing is a model for delivering computing services—such as storage, processing, and analytics—over the internet (i.e., the cloud) rather than on local servers. This model offers scalability, flexibility, and real-time access while providing a cost-effective infrastructure for data access, storage, and analysis. Moving to cloud-based solutions allows organizations to manage large datasets efficiently, improve data interoperability, and ensure reliable system uptime. EPH professionals benefit from understanding the fundamentals of cloud computing, including service models (e.g., IaaS, PaaS, SaaS) and strategies for securely migrating legacy systems to cloud environments.

Example:

A regional air quality monitoring program transfers its historical sensor data and real-time feeds to a cloud-based platform like Amazon Web Services (AWS). This facilitates continuous uptime, enables remote data access for inspectors in the field, and promotes cross-agency collaboration free from the limitations of local servers.

Data Sharing: Enhancing Collaboration and Transparency

Data sharing is the intentional and secure exchange of data between organizations, systems, or users to support collaboration, improve services, and enhance public transparency, all while maintaining data privacy and control. Strategic data sharing promotes collaboration, innovation, and transparency among EPH agencies and within the broader community. Effective data sharing entails clear agreements that outline data usage, privacy considerations, access controls, and interoperability standards. The use of secure data-sharing platforms, standardized APIs, and comprehensive metadata improves the efficiency of data exchange, enabling coordinated public health responses and stronger community engagement.

Example

A coastal health district signs a data-sharing agreement with a local university and wastewater treatment facility to exchange surveillance data on waterborne illnesses. Using standardized APIs, they combine environmental sampling data, illness reports, and weather information to identify and respond to contamination events more quickly.

Mastery of these advanced topics enables EPH professionals to navigate and leverage emerging technologies and practices, greatly enhancing their ability to address complex public health challenges.



Section 7: Charting the Path Forward: Strategic Guidance and the Road to Implementation

EPH agencies play a crucial role in protecting public health and enhancing community resilience. As outlined throughout this guide, data modernization is more than a technological upgrade—it represents a strategic transformation that enables responsive, unbiased, and informed EPH practice.

Adoption of modern systems, enhancement of data literacy, development of foundational skills, and adherence to the FAIR principles enable agencies to unlock capabilities that were once considered aspirational. Real-time analytics, geospatial visualization, and predictive modeling have become essential tools for addressing urgent public health challenges, from disease outbreaks to climate-related emergencies.

Case studies from jurisdictions such as California, San Bernardino County, Tennessee, and Texas showcase the tangible results of modernization, including enhanced transparency, improved operational efficiency, and increased public engagement. The integration of secure AI, cloud-based systems, and cybersecurity protocols highlights the significance of a comprehensive, forward-thinking strategy for data management.

While the benefits are clear, agencies still face common barriers such as limited resources, aging infrastructure, and cultural resistance to change. These challenges, however, can be addressed through strategic planning, phased implementation, sustained leadership, and a commitment to workforce development. Data modernization is a continuous process, not a one-time achievement. It requires investment, collaboration, and ongoing adaptation to emerging technologies and evolving public health needs.

Call to Action

The current moment demands decisive action. EPH agencies are encouraged to take intentional steps to update their data systems and operational practices. A data-informed culture, grounded in ethical principles and fairness, is crucial for meeting current and future public health challenges.

It is important for leadership to treat modernization as a strategic necessity, advocate for institutional investment, and foster a culture of continuous improvement. Professional staff at all levels are essential to this transformation through skill development, cross-sector collaboration, and effective data management. To support these efforts, Table 14 includes recommended key actions.

Table 14

ACTION	PURPOSE
Assess and Prioritize	Review current data assets, systems, and organizational readiness. Identify gaps, risks, and opportunities to guide modernization priorities.
Center Fairness and Transparency	Embed principles of equity, accessibility, and inclusion in all modernization activities, with a focus on reaching underserved communities.
Build Workforce Capacity	Expand training to improve data literacy, analytical capabilities, and fluency with emerging technologies across the agency.
Implement Strong Governance	Establish policies that protect data privacy, ensure quality, and uphold ethical standards in data use and sharing.
Foster Cross-Sector Partnerships	Collaborate with academic institutions, peer agencies, and technology partners to share resources, apply best practices, and scale innovation.
Collaborate Across Jurisdictions	Partner with other agencies to co-develop and manage data systems, sharing costs, staff time, and technical expertise so that limited resources go further and more agencies can benefit from the system's capabilities.
Track, Evaluate, and Adapt	Monitor performance using clear indicators, gather ongoing feedback, and refine strategies to sustain momentum.

Commitment to these priorities enables EPH programs to enhance their resilience, expand their impact, and maintain public trust. Data modernization is not only a technical task but also a strategic obligation that fosters more transparent, equitable, and effective public health systems.

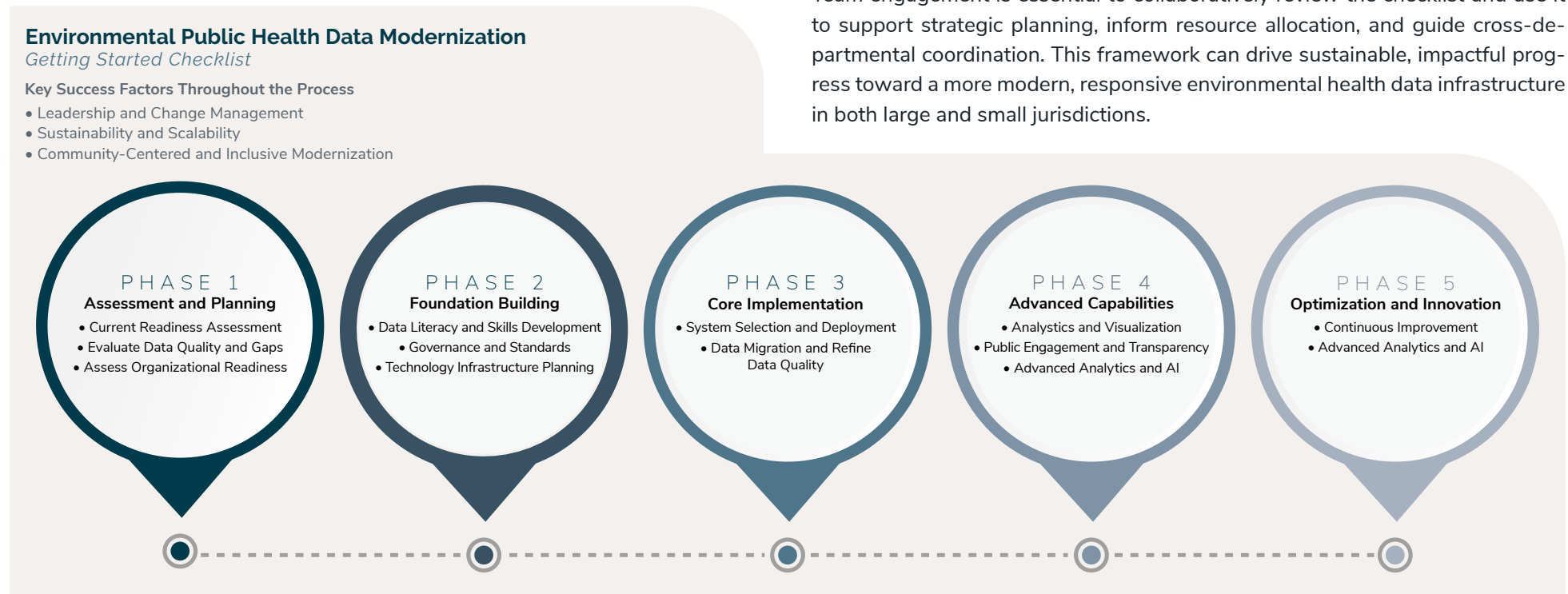
Getting Started: A Checklist for Data Modernization

The initiation of data modernization can be a complex endeavor, particularly for under-resourced agencies or those managing legacy systems. To aid early planning and alignment, the following checklist offers a structured yet flexible starting point.

This tool outlines essential steps to evaluate readiness, build internal momentum, and align modernization strategies with organizational goals and community needs. It is intended to function not as a strict sequence but as a flexible guide that can be customized to diverse contexts, capacities, and priorities.

Team engagement is essential to collaboratively review the checklist and use it to support strategic planning, inform resource allocation, and guide cross-departmental coordination. This framework can drive sustainable, impactful progress toward a more modern, responsive environmental health data infrastructure in both large and small jurisdictions.

Figure 2



Environmental Public Health Data Modernization: Getting Started Checklist

The Environmental Public Health Data Modernization: Getting Started Checklist is a practical guide to help your agency strengthen its data systems in a step-by-step approach. This checklist provides clear directions for tailoring your organization's specific needs and goals. Designed for flexibility, it supports both early efforts and long-term strategies. Each phase builds on the last, emphasizing leadership, impartiality, sustainability, and collaboration as key success factors throughout the process. Start small, if needed, pilot a program, capture early wins, and build from there. By following this checklist, your team will be better equipped to make informed decisions, improve public service, and meet evolving public health challenges.

This tool outlines essential steps to evaluate readiness, build internal momentum, and align modernization strategies with organizational goals and community needs. It is intended to function not as a strict sequence but as a flexible guide that can be customized to diverse contexts, capacities, and priorities.

Team engagement is essential to collaboratively review the checklist and use it to support strategic planning, inform resource allocation, and guide cross-departmental coordination. This framework can drive sustainable, impactful progress toward a more modern, responsive environmental health data infrastructure in both large and small jurisdictions.

Key Success Factors Throughout the Process

These foundational elements should be considered throughout every phase of modernization, not just at the end.

Leadership and Change Management

- Secure sustained leadership commitment and resources
- Communicate benefits and progress regularly to all interested parties and partners
- Address resistance to change through training and support
- Celebrate quick wins and recognize staff contributions

Community-Centered and Inclusive Modernization

- Ensure modernization efforts benefit all communities
- Include community voices in planning and implementation
- Design systems to serve diverse populations effectively
- Monitor and address potential digital divides

Sustainability and Scalability

- Plan for long-term financial sustainability
- Design systems that can grow and adapt over time
- Build internal capacity to maintain and enhance systems
- Establish partnerships that support ongoing success

Resources and Support

- Connect with professional organizations (e.g., NEHA, state associations)
- Participate in relevant training and certification programs
- Engage with vendor user communities and support networks
- Establish relationships with other modernizing jurisdictions for knowledge sharing

Phase 1: Assessment and Planning

1. Current Readiness Assessment

□ Inventory Existing Data Systems

- Document all current databases, spreadsheets, and paper-based processes
- Identify data silos and disconnected systems
- Assess mobile versus desktop usage patterns
- Map current data workflows from collection to reporting

□ Evaluate Data Quality and Gaps

- Review for accuracy, completeness, consistency, and timeliness of existing data
- Identify missing metadata and documentation
- Assess compliance with privacy regulations (e.g., HIPAA, state laws)
- Document known data quality issues

□ Assess Organizational Readiness

- Evaluate current staff data literacy levels
- Identify internal IT capacity and constraints
- Review budget availability for modernization efforts
- Assess leadership commitment and change management capacity

2. Strategic Planning

□ Define Modernization Goals and Priorities

- Establish clear objectives (e.g., efficiency, transparency, emergency response)
- Prioritize quick wins versus long-term transformational goals
- Align with organizational mission and community needs
- Set measurable success metrics

□ Conduct Interested Partner Analysis

- Identify who is impacted by the project and what they need
- Identify key internal partners (e.g., staff, leadership, IT)
- Map external partners (e.g., other agencies, community organizations)
- Assess public engagement and transparency requirements
- Document partner needs and concerns

□ **Develop a Phased Implementation Plan**

- Create a realistic timeline with milestones
- Identify pilot programs or departments for initial rollout
- Plan for staff training and change management
- Build in evaluation and adjustment periods

Phase 2: Foundation Building

3. Data Literacy and Skills Development

□ **Assess Current Capabilities**

- Survey staff on existing data skills and comfort levels
- Identify data champions within each program area
- Evaluate training needs across different roles

□ **Deliver Foundational Training**

- Provide basic data literacy training for all staff
- Offer specialized training for key personnel (e.g., GIS, visualization, analysis)
- Establish ongoing professional development programs
- Create internal knowledge sharing processes

4. Governance and Standards

□ **Establish Data Governance Framework**

- Set clear rules about who manages and uses the data
- Decide who takes care of the data and how they should do it
- Create data quality standards and procedures
- Develop steps to protect private information and keep data safe
- Establish data sharing agreements and policies

□ **Adopt Standardization Practices**

- Research relevant standards (e.g., HL7, LOINC, and ISO frameworks)
- Standardize data definitions and formats across programs
- Create data dictionaries and documentation templates
- Implement consistent naming conventions

5. Technology Infrastructure Planning

□ **Evaluate Technology Options**

- Research environmental health management systems
- Assess cloud versus on-premise solutions
- Verify if new systems can work with what you already use
- Consider mobile-first approaches for field work

□ **Plan Security and Compliance Measures**

- Implement multifactor authentication
- Plan encryption protocols for data at rest and in transit
- Establish backup and disaster recovery procedures
- Ensure compliance with relevant regulations

Phase 3: Core Implementation

6. System Selection and Deployment

□ **Select Core Platforms**

- Choose a primary environmental health management system
- Select a GIS platform
- Identify preferred data visualization tools
- Plan for mobile data collection solutions

□ **Implement Foundational Systems**

- Deploy a centralized data storage and management system
- Establish secure access controls and user permissions
- Integrate systems where possible to reduce data silos
- Set up automated backup and security monitoring

7. Data Migration and Refine Data Quality

□ **Plan Data Migration**

- Clean and standardize existing data before migration
- Create comprehensive metadata for all datasets
- Test data integrity throughout the migration process
- Maintain parallel systems during the transition period

□ **Implement Quality Assurance Processes**

- Establish regular data quality audits
- Create automated validation rules where possible
- Train staff on best practices for data entry
- Implement feedback loops for continuous improvement

Phase 4: Advanced Capabilities

8. Analytics and Visualization

□ **Develop Reporting Capabilities**

- Create standardized dashboards for different user types
- Implement real-time monitoring for crucial metrics
- Build public-facing transparency portals
- Establish automated report generation where appropriate

□ **Enhance Spatial Analysis**

- Implement comprehensive GIS capabilities
- Create mapping dashboards for operational use
- Develop spatial analysis workflows for risk assessment
- Train staff in geographic analysis techniques

9. Public Access and Transparency

□ **Develop Public-Facing Tools**

- Create open data portals where residents, researchers, and organizations can view and download relevant environmental health data
- Implement interactive dashboards showing key health metrics, inspection results, and environmental indicators
- Develop mobile-friendly access to public information
- Establish multilingual access where needed

□ **Enable Easy Access to Records and Services**

- Offer online permit application and renewal systems with status tracking
- Provide searchable databases for inspection histories, compliance records, and environmental monitoring results

- Allow secure online submission and tracking of complaints or service requests

□ **Support Data Understanding and Use**

- Include plain-language explanations and data dictionaries alongside technical datasets
- Provide downloadable datasets in open, machine-readable formats (e.g., CSV, JSON)
- Offer simple visualization tools that allow users to filter and explore data by location, time, or topic

Phase 5: Optimization and Innovation

10. Advanced Analytics and Artificial Intelligence

□ **Explore Predictive Capabilities**

- Implement anomaly detection for early warning systems
- Develop predictive models for resource planning
- Explore AI applications for routine tasks
- Establish ethical guidelines for AI use

□ **Enhance Automation**

- Automate routine reporting and notifications
- Implement workflow automation for common processes
- Explore automated data collection from sensors or external sources
- Establish intelligent routing and scheduling systems

11. Continuous Improvement

☐ **Establish Feedback Mechanisms**

- Regular user satisfaction surveys
- Performance metrics tracking and analysis
- Partner feedback collection and review
- Regular system performance assessments

☐ **Plan for Future Growth**

- Stay current with emerging technologies and trends
- Continue education with adopted platforms to stay current with updates
- Participate in professional networks and communities of practice
- Budget for ongoing system maintenance and upgrades
- Plan for staff succession and knowledge transfer
- Enhance community engagement with data

This checklist should be adapted to the specific needs, resources, and timeline of your organization.

Glossary of Terms

Accessibility (data)

The ease with which users can obtain and understand data, including support for disabilities and multilingual access.

Accountability

Ensuring strong governance, oversight, and ethical responsibility throughout all data processes.

ALICE

A live interactive customer experience; a public self-service kiosk.

API

Application programming interface; allows different software systems to communicate and exchange data.

ArcGIS Dashboards

Esri tool for real-time visual display of spatial and performance data.

ArcGIS Experience Builder

A platform for building interactive web apps that combine maps and narrative content.

ArcGIS Online (AGOL)

Esri's cloud-based platform for sharing and analyzing spatial data.

ArcGIS Pro

Esri's desktop GIS software for advanced mapping and spatial analysis.

Artificial intelligence (AI)

Technologies that simulate human intelligence for tasks such as pattern detection and automation.

CARTO

Cloud-based spatial analytics platform for mapping and geospatial insights.

Citizen or participatory science

Community-driven data collection and monitoring efforts.

Dashboard

A digital interface showing real-time visual data summaries and indicators.

Data Access

Ensuring authorized users can easily and securely obtain the data, in usable and interoperable formats.

Data Analysis

Applying statistical and analytical techniques to identify trends, relationships, and insights for decision-making.

Data Collection

The process of systematically gathering accurate, consistent, and relevant data from multiple sources to support program goals and decision-making.

Data dictionary

Reference document explaining data fields, formats, and rules.

Data governance

Policies and processes ensuring secure, ethical, and effective data management.

Data literacy

The ability to read, understand, and communicate data effectively.

Data modernization

The process of upgrading and digitizing public health data systems.

Data stewardship

Responsible management of data with attention to ethics, privacy, and quality.

Environmental health informatics

Integration of the environmental health practice with IT and analytics to improve decision-making.

Environmental health management system (EHMS)

Software used for managing environmental health programs such as inspections and permits.

ETL

Extract, transform, load; the process of preparing data for analysis.

Experience Builder

See ArcGIS Experience Builder.

FAIR principles

Findable, accessible, interoperable, reusable; best practices for data management.

Field Maps

Mobile Esri app for mapping, data collection, and navigation.

Fulcrum

A mobile platform for field data collection with offline support.

GIS

Geographic information system; Technology for capturing, storing, and analyzing spatial data.

Geopandas

Python library for working with geospatial data in tabular formats.

Google Earth Engine

A platform for large-scale analysis of satellite imagery.

Health outcome data

Data on illnesses or conditions linked to environmental exposure.

HL7

Health Level Seven; standards for health data exchange.

Image classification

AI-based technique to categorize objects in aerial or satellite imagery.

Interoperability

The ability of systems to exchange and use shared data.

Interpretation

Turning analytical results into meaningful conclusions that add context, guide actions, and communicate value to stakeholders.

ISO standards

International standards for consistency in GIS, metadata, and quality management.

LOINC

Standard for identifying laboratory and clinical observations.

Mapbox

Tool for building custom, web-based maps and visualizations.

Metadata

Descriptive information about a dataset's origin, structure, and use.

Natural language processing (NLP)

AI method for analyzing and interpreting human language data.

Open data

Public data that is freely available for use and sharing.

Performance metrics

Indicators used to evaluate EPH program effectiveness and efficiency.

Predictive modeling

Techniques used to forecast future events based on existing data.

Privacy (data)

Protection of personal or sensitive data in compliance with regulations.

Public-facing portal

Online tools for residents to access EPH services and data.

Python

Programming language for automating tasks and analyzing environmental health data.

QGIS

Free, open-source GIS software used for mapping and spatial analysis.

R

Statistical programming language used for modeling and epidemiological studies.

Real-time data

Data made available immediately or with minimal delay.

Redistricting (GIS)

Redrawing of district boundaries using GIS for workload balance and efficiency.

Remote sensing

Collecting data from satellites or aircraft to monitor environmental conditions.

SAS/SAS Viya

Analytics software used in public health for analysis and visualization.

Smartsheet dashboards

Tools for basic project and data visualization within the Smartsheet platform.

SQL

Structured query language; used to manage and query databases.

Storytelling (data)

Using visuals and narratives to communicate public health insights.

Survey123

Esri tool for form-based mobile data collection synced with GIS.

Timeliness (data)

How current or up-to-date data are for decision-making.

Transparency

Open sharing of data and processes to foster public trust.

Uptime

The period when a system, application, or service is operational and available without interruptions.

Vector control

Environmental health strategies to reduce disease-carrying organisms such as mosquitoes.

Visualization

Graphical representation of data through maps, charts, or dashboards.

Workforce for ArcGIS

Esri tool for assigning and managing mobile field tasks.

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