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Perspective

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A messaging standard for environmental inspections: is it time?

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Abstract

Environmental health (EH) services in the United States lag behind other areas of public health and health care with respect to information system interoperability and data sharing. This is partly due to an absence of well-defined use cases, the lack of direct economic drivers and resources to improve, the multiple jurisdictional elements that govern EH services across the United States, and no central organization to drive modernization of EH data. We summarize the status of EH information systems; argue for greater interoperability, including use cases for a messaging standard for environmental inspections; and present recommendations to better align EH services and data modernization efforts currently underway in other areas of public health.

Key words: environmental health; messaging; inspections; data standards; public health informatics.

Introduction

Environmental health (EH) services include regulation of food safety, water quality and air quality, land use inspection and approval for housing, and control of common environmental and occupational hazards like lead, asbestos, and radon.[1] The breadth and diversity of EH services, and the number of agencies involved in their delivery, involve a large number of data elements, definitions, terminology, and nonstandardized vocabularies (Table 1).[2,3] Due to the roles of numerous federal agencies involved in the delivery of EH services by thousands of state and local governments, there are few national standards for data formats and messaging. While there are data standards (such as HL7) and frameworks to promote interoperability (such as the U.S. Core Data for Interoperability) for many types of health data, most EH information systems lack interoperability despite significant content overlap, especially those focused on regulatory processes (eg, inspections, licensure, and enforcement).[4] Instead, EH data standards are developed by individual states and localities, if at all.

The lack of interoperability poses significant problems for the efficient delivery of EH services, as evidenced by the data modernization efforts to improve interoperability that have been sponsored recently by the U.S. Centers for Disease Control and Prevention (CDC).[5,6] For example, currently, agencies have no way other than email or phone inquiries to share information about regulated industries implicated in disease outbreaks, even when such information is critical to identifying where outbreaks might have originated as well as informing clinical interventions for exposed persons to reduce morbidity and mortality.

Consider an outbreak of Salmonellosis potentially linked to food. Rapid sharing of whole genome sequencing data across the country permits the prompt identification of clusters from clinical isolates. By contrast, while local and state health departments (or in some cases agriculture departments) may inspect food facilities, there is frequently no way to share potentially relevant information from these facility inspections unless a department summarizes the information manually in response to specific requests, resulting in delays to interventions and treatment recommendations that could be reduced with standard data messaging. The lack of interoperability also vastly increases the difficulty and cost of making EH data publicly accessible. For example, CDC's Environmental Public Health Tracking project noted the lack of data standards as one of its critical challenges.[7]

In this respect, EH services data management is comparable to health care in the 1980s, when a plethora of electronic health records platforms operated with different data standards and little interoperability. In response, Health Level Seven (HL7) was developed as a messaging standard that would allow hospitals and healthcare institutions to share data across different platforms without having to modify the architecture of the systems themselves.[8] A messaging standard for EH data could produce benefits similar to those of HL7 to public health, EH, and clinical systems.

The potential value of integrating EH services data with other public health and healthcare data flows is shown in Figure 1. Like other social determinants of health, natural and built environments play a significant role in shaping the health of individuals and communities.[9] However, there are no readily available mechanisms to link environmental data to patient-level health records or population health data. Enabling such linkages can provide healthcare providers, public agencies, communities, and

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Table 1. Environmental health services data and systems.

Topic	Agent(s)/measures	System(s)	Lead agency	Data types	Potential uses		
					Regulatory	Health/ epidemiology	Policy/risk assessment
Air quality	Criteria air pollutants	Air Quality System (AQS)	EPA	R, M	X	X	X
	Hazardous air pollutants	AQS and 2020 Ambient Monitoring Archive for the Hazardous Air Pollutants (HAPs)	EPA	R, M	X	X	X
	Emissions	Emissions Inventory System (EIS)	EPA	R, M	X	X	X
Water quality	Drinking water	Safe Drinking Water Information System (SDWIS)	EPA	R, M	X	X	X
	Surface water/recreational water	Assessment, Total Maximum Daily Load Tracking And Implementation System (ATTAINS)	EPA	R, M	X		X
		Water Quality Exchange (WQX)	EPA	R, M	X	X	X
Land/solid waste management	Hazardous waste	Resource Conservation and Recovery Act Information System (RCRAInfo)	EPA	R	X		
	Regulated medical waste	None	States		?	?	?
Facility discharge information	Air and water discharges[a]	Integrated Compliance Information System (ICIS)	EPA	R, M	X		X
	Facility substance-specific discharges	Toxics Release Inventory (TRI)	EPA	R, M	X	X	X
Food safety	Food safety data[b]	Office of Regulatory Affairs Data Exchange (ORA DX)	HHS/FDA	R, M	X	X	X
	Food safety and inspection data	Public Health Inspection System (PHIS)	USDA/FSIS	R, M	X	X	X
	Environmental assessments from foodborne outbreaks	National Environmental Assessment Reporting System (NEARS)	HHS/CDC	R, M	X	X	X
Hazard-specific data	Lead	Healthy Homes and Lead Poisoning Surveillance System (HHLPSS)	HHS/CDC	M, H	X	X	X
Human health data	Outbreaks	National Outbreaks Reporting System (NORS)	HHS/CDC	R, M, H	X	X	X
	Notifiable diseases and conditions	National Notifiable Disease Surveillance System (NNDSS)	HHS/CDC	H	X	X	X
Workplace safety	Workplace-specific inspection and enforcement	Integrated Management Information System (IMIS)	DOL/OSHA	R, M, H	X	X	X

Abbreviations: DOL/OSHA, U.S. Department of Labor Occupational Safety and Health Administration; EPA, U.S. Environmental Protection Agency; H, health data (exposure assessment and health outcomes assessment); HHS/CDC, U.S. Department of Health and Human Services/Centers for Disease Control and Prevention; M, monitoring/measurement data (environmental monitoring); R, regulatory processes data (licensing/permitting, enforcement, and compliance); USDA/FSIS, U.S. Department of Agriculture/Food Safety and Inspection Service.

[a] More information about the multiple environmental data contained within the U.S. EPA Integrated Compliance Information System (ICIS) can be accessed at: https://echo.epa.gov/resources/echo-data/about-the-data#sources.

[b] More information about the multiple food safety data contained within the U.S. FDA's Office of Regulatory Affairs Data Exchange can be accessed at: https://orapartners.fda.gov/webcenter/portal/ORAPARTNERS/pages_dataexchangeoverview.

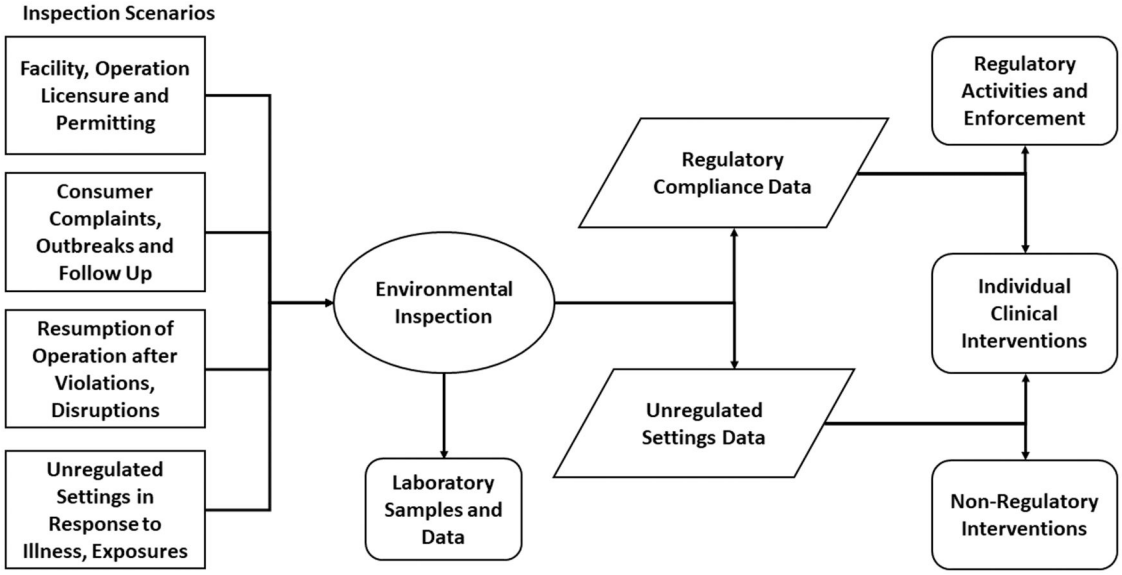

Figure 1. Environmental health data flow and sources.

individuals with insights into the upstream causes and contributors to health, and the means to address them.

A central feature of EH services is the environmental inspection (EI). The physical process of a site-based evaluation of a home, manufacturing facility, farm, restaurant, pool, onsite sewage disposal system, or disaster site (to name some venues subject to EIs) with its attendant observations, findings, and recommendations, has no common data or messaging framework. Despite widespread use of inspection data in many EH information systems, there is no common messaging standard for the inspection processes common to many EH services. This represents an opportunity to improve data sharing and interoperability for the many agencies involved in EH services. We propose a series of use cases to develop a framework for a messaging standard for EIs.

Elements of EIs

The potential opportunities for more systematic data collection in EIs have been described as part of a recent effort to develop an overall EH informatics framework to improve the use of EH data to inform decision-making and support evidence-based practices.[10] EIs consist of: (1) administrative identification of the facility/entity being inspected; (2) the reason for the inspection, and the authority under which it is conducted; (3) observations or findings, which may include subjective observations and/or objective data (including laboratory data); (4) recommended or required actions, if applicable; and (5) additional follow-up actions such as re-inspections.

Standards for some data elements within EIs already exist. Administrative data related to the organization conducting the inspection, and to the facility or entity being inspected, include legal names or identifiers, geographic identifiers, and organizational or functional identifiers. Many of these exist as standards in other areas, but not yet in health or public health settings. Standards also exist for environmental monitoring and clinical laboratory data. Depending on the type of inspection being conducted, there may be standards for the objective data and for the recommended or required actions flowing from the inspection.

What is needed is a messaging framework for the entire EI process, to allow EI data to be exchanged with other public health information systems and electronic health records. One example is the messaging standard proposed for the National Food Safety Data Exchange (NFSDX). That standard, under development by the Partnership for Food Protection and the U.S. Food and Drug Administration (FDA), includes many of the elements described above, though it is focused on inspections of food-related facilities.[11] Another is the recently released Standard for Aquatic Facility Environments (SAFE-D).[12] To create a more generalized messaging standard for the many different types of EH inspections, some possible use cases are described below.

Use cases for a common messaging standard for EH inspections

The use cases for a common EI messaging standard would apply both all EIs of regulated facilities, and to inspections of all settings prompted by complaints of illnesses or environmental exposures. Most EIs by EH staff are routine EIs of regulated facilities such as licensed food service facilities; construction and operating permits for pools; health and safety inspections in workplaces; or construction and operation inspections for wells and septic systems. These typically consist of standardized observations related to regulated physical and operational characteristics, environmental measurements and laboratory samples, and administrative data. While these data elements are generally standardized with respect to content within regulatory subject area (food service or pools, eg), data formats and structure are only beginning to be standardized and are often inconsistent between and among data systems and subject area, despite the fact they are often conducted by the same organization and housed in similar data systems.

Consider as a use case an outbreak of an infectious gastrointestinal illness in a local jurisdiction, in which a suspect agent is identified through electronic reporting of clinical specimens to a health department. If epidemiologic or laboratory findings suggest links to regulated settings (a restaurant, pool, or workplace such as a slaughtering operation), an EI is initiated. The EI collects data about physical conditions in the facilities, along with associated environmental samples. It will also often link to prior routine or complaint-based inspections, looking for potential prior incidents or violations that could explain the outbreak. These EIs often involve several local, state, territorial, tribal, and/or federal agencies and data systems. However, while laboratory and clinical data are standardized, the descriptions of the physical facility conditions, business operations, sampling locations, and other associated environmental information are generally collected as free text (even electronically), and different agencies format and collect the data separately. FDA's NFSDX and the recently proposed SAFE-D standard for aquatic facilities are initial efforts to standardize these data through direct system-to-system data exchange using standard message constructs for food service or manufacturing facilities, or regulated swimming facilities.[12,13] The U.S. Centers for Disease Control and Prevention (CDC) uses the National Outbreak Reporting System (NORS) to collect data on outbreaks, but it is not interoperable with FDA systems or local jurisdictional data systems.[14] The U.S. Occupational Safety and Health Administration, or state occupational health regulatory systems, use still other systems when inspecting workplaces.[15]

A second use case involves home inspections by a local health department in response to an environmental condition such as lead poisoning or asthma, now standard in some states like Maryland.[16] Common data elements for these EIs include the physical location and legal ownership of the residence; observations such as the presence of peeling paint or asthma triggers; environmental sampling for lead; findings of legal compliance/noncompliance with regulations and codes; and recommended/required corrective actions. These elements are pertinent for the public health authority, other enforcement authorities, and the clinical provider treating the patient, but they usually are nonstandardized and cannot be directly shared between data management systems.

A third use case involves EIs of facilities in response to suspected contamination from infectious or chemical/physical contaminants. For example, a local health department might conduct EIs and well water sampling in response to an environmental release in a chemical spill or investigate contamination after a release from a wastewater treatment facility. The findings from these EIs could then be linked to syndromic surveillance or other clinical information, based on standardized location data and findings.

In each of these cases, there is enormous potential value in the ability to link EIs data to public health surveillance data and with health care data in the medical record. Public health and regulatory agencies would benefit from the ability to rapidly determine the conditions and violations at regulated facilities early in an outbreak, which can often provide the link between environmental sample results and clinically diagnosed illness. Healthcare providers would benefit from having standardized observations from home visits automatically populated in the medical record. And in a postdisaster recovery, the ability to quickly and efficiently link EIs to environmental monitoring and health data will be essential for both the public health response to environmental releases, and business recovery.

Conclusion

The development of a common messaging standard for EIs will increase data sharing and interoperability of EH information systems and promote the use of inspection data within more public health applications and inform clinical decisions. It offers an opportunity to share data from EIs in clinical electronic health records, among public health agencies, and with businesses and the public. The Federal Government's data modernization initiative provides an opportunity to develop these use cases and improve linkages between EH data and public health. Mechanisms such as the U.S. Core Data for Interoperability+ (USCDI+) may provide a useful framework for these efforts.[17] Key stakeholders in EH, including Federal and state EH agencies, nongovernmental organizations, and private sector would all benefit from establishing a collaborative effort to develop the key data elements, existing and needed value sets for an EH inspection data message within a framework such as USCDI+.

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Author contributions

C.S.M. is responsible for the overall conception of the work, drafting, and final manuscript approval. T.C. contributed significantly to the analysis and drafting and approved the final manuscript. E.F. reviewed and contributed significantly to the final manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Conflicts of interest

The authors have no competing interests to declare.

Data availability

No new data were generated or analyzed in support of this research.

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