Workforce Acceleration Initiative

Public Health Agency Information Infrastructure Maturity Model

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Purpose

The Workforce Acceleration Initiative (WAI) PHA Information Infrastructure Maturity Model (herein referred to as WAI Maturity Model) was developed by the CDC Foundation to assess information systems improvement at public health agencies/authorities (PHAs) that have WAI technology and data experts placed at their organization.

Forty-nine (49) diverse state, local, Tribal and territorial PHAs are participating in WAI. The WAI Maturity Model provides a framework to demonstrate both individual and cumulative progress of WAI PHAs towards the Centers for Disease Control and Prevention's (CDC's) Public Health Data Strategy (PHDS) while still accounting for the diversity of projects. The model further creates a framework for demonstrating how foundational improvements at PHAs can build a path towards future work on specific PHDS milestones.

More broadly, the model can support PHAs of all types to consider how they might modernize their information systems and to clarify how those improvements align with the PHDS even if they are foundational in nature.

Model Development

The model is grounded in CDC's Data Modernization Initiative priorities and the PHDS goals and milestones. The five data modernization priorities shared by CDC (listed below) were used

to define the WAI Maturity Model's four dimensions (Information System Improvement Strategy and Governance; Workforce; Partnerships and Networks; and Technology).

1. Managing Change and Governance (maps to Information System Improvement Strategy and Governance dimension)
2. Developing a State-of-the-Art Workforce (maps to Workforce dimension)
3. Supporting and Extending Partnerships (maps to Partnerships and Networks dimension)
4. Building the Right Foundation (maps to capabilities within Technology dimension)
5. Accelerating Data into Action (maps to capabilities within Technology dimension)

The WAI Maturity Model presents 22 capabilities grouped into these four dimensions. The capabilities within the Technology dimension are mapped to CDC's PHDS goals in Appendix D.

Building from this foundation, the WAI Maturity Model capabilities and scales were refined based on a review of public health and health technology maturity and adoption models.[2] We also held conversations with partner organizations in the field of public health information system improvement to inform capabilities and scales.

Most technical capabilities of the WAI Maturity Model were based on a draft set of capabilities developed in 2013 by the National Association of County and City Health Officials (NACCHO) Informatics Workgroup. Some capabilities were adapted from or informed by the Informatics-Savvy Health Department Self-Assessment Tool published by Public Health Informatics Institute (PHII), which is used by PHAs across the nation to "…[define] necessary informatics capabilities and [enable] a self-assessment that aids in planning and priority setting."[1] Other capabilities were developed based on existing public health and health informatics and technology maturity and adoption models.[2] Further, we gathered feedback from experts in public health information systems, WAI project team members and WAI PHAs. Where meaningful overlap exists, we cite where the WAI Maturity Model was adapted from, informed by or aligned with these other resources to demonstrate congruence with work in this field.

A Note on Public Health Assessments: For public health departments that wish to further assess their informatics readiness, we suggest considering usage of the Public Health Informatics Institute's (PHII) Informatics Savvy Health Department Toolkit. This toolkit contains an assessment that allows users to collaboratively identify strategic activities to build informatics capacity and analyze current informatics readiness across the agency. The toolkit may be found at phii.org/info-savvy. For any other questions on the PHII informatics-savvy assessment, please email info@phii.org. The WAI Maturity Model is designed to be completed by one person which is different from the Informatics-Savvy Health Department Self-Assessment Tool which is designed to be used in a group setting to gain consensus.

Based on recent critique that many existing technology maturity models focus on the development of the capability but not necessarily its adoption or use across an organization,[3] we designed the WAI Maturity Model scales to reflect two components: **the PHA's development** of that capability and **how widely the capability is adopted** across the PHA's data systems, departments and programs. **Figure 1** provides definitions for the different scale levels used

[1] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/
[2] Refer to Appendix E for complete list of resources consulted.
[3] Koenders W. (2024). "Data maturity models — Why having the capabilities in place isn't enough." Accessed 08/01/24. Available at: https://medium.com/@willemkoenders/data-maturity-models-why-having-the-capabilities-in-place-isnt-enough-30edd2634bf6

throughout the model. Scale definitions stem from an assessment of a wide range of models around public health and health technology maturity and organizational adoption.[2] Many of these scales build upon the scholarship from Carnegie Melon University's Software Engineering Institute in developing the Capability Maturity Model (CMM) tool.[4]

Some capabilities have more than five scale levels because there were meaningful milestones to capture on the PHA information systems improvement journey. In these instances, the five levels outlined in **Figure 1** are retained; however, PHAs may be categorized as being in an early stage or a mature stage for the level. The scales are to measure a PHA's progress in specific capabilities and are not intended to offer an overall "score" or to provide comparisons between PHAs.

Capabilities may not be achieved by the PHA alone. Achieving capabilities likely requires partnerships within public health and beyond. Further, some PHAs, such as city or county PHAs, must rely on other PHAs – such as the State – to support their ability to achieve maturity model capabilities.

[4] Software Engineering Institute. (1993). Capability Maturity Model for Software, Version 1.1. Pittsburg: Carnegie Mellon University.

Figure 1. WAI Maturity Model 5-Level Capability Scale Definitions [5]

	Level 1	Level 2	Level 3	Level 4	Level 5
	Not Started	**Adhoc and Individual**	**Developing and Strategic**	**Standardized and Integrating**	**Ongoing Improvement and Full Integration**
Component: Capability Development	The capability is not present.	There is little alignment across the PHA around capability activities. Capability may exist in an adhoc, reactive and/or inconsistent fashion.	PHA is taking a more organized approach to plan and develop the capability. Planning considers implementation, strategies for PHA-wide adoption and evaluation. PHAs in this level may be testing solutions by developing use cases and conducting pilots.	Capability is standardized, documented and enhanced over time. The PHA has defined a PHA-wide strategy for the capability and has begun measuring adoption and impact.	PHA consistently measures adoption and impact. The capability is continuously monitored and improved based on performance data and engagement of affected parties.
Component: Capability Development (Interoperability Scales Only)	No data exchange between systems.	Some data is exchanged, but it is not standardized or reliable.	Some data exchange is standardized and automated, but integration is still limited.	Most systems are well-integrated, allowing for seamless data flow.	Real-time, bidirectional data exchange occurs in most places it is needed. The data exchange is continuously monitored and improved based on data and engagement of affected parties.
Component: Organizational Adoption of Capability	No one at the PHA has or is using the capability.	PHA has growing awareness around capability's importance; however, any efforts to adopt capability are individually organized.	Some areas of the PHA are beginning to implement the capability in alignment with PHA planning and development activities.	PHA projects, teams and systems are integrating the defined, PHA-wide strategy for the capability into their daily workflows.	Where applicable, all PHA projects, teams and systems use the capability and/or follow standards in daily workflows.

Scale Functionality							
7 Point Scale	**L1**	**Early L2***	**Mature L2**	**Early L3**	**Mature L3**	**L4**	**L5**
6 Point Scale**	**L1**	**L2**		**Early L3**	**Mature L3**	**L4**	**L5**
5 Point Scale	**L1**	**L2**		**L3**		**L4**	**L5**

** Within a capability where there may be meaningful progress made within one Level, the Capability may have two measures of progress within one Level.*

** For 6 Point Scales, Level 2, Level 3 or Level 4 may be broken down into early and mature. This shows an example where Level 3 is broken down into early and mature.*

[5] Refer to Appendix E for complete list of resources consulted.

How to Complete WAI Maturity Model Questions

Definitions

Within the WAI Maturity Model, the term ***Information Systems Improvement (ISI) Vision and Strategy*** is used. To ensure PHAs assessing themselves understand what is meant by this phrase, select definitions are outlined below.

- **Information Systems**: includes hardware, software and data as well as the related staff, work processes and policies that support PHA teams and partners in accessing timely, relevant, high quality information that informs decision making.
- **Information Systems Improvement (ISI) Vision**: the future state that is the goal of information systems improvement activities. For example, an PHA's ISI vision might be, "All PHA teams can access timely, accurate and comprehensive information that meets their needs and supports decision making."
- **Information Systems Improvement (ISI) Strategy**: a plan or roadmap describing the steps that a PHA plans to take to achieve its vision.

Many PHAs may refer to ISI strategies as informatics capability and/or data modernization plans. ISI strategies may address work processes as well as the systems that capture, store, manage and use data. Improvements may focus on streamlining and automating processes, simplifying or expanding data capture, improving the tools, such as hardware or software, used for that work, or improving data quality, including its timeliness, accuracy and usability. Improvements should be driven by the needs, preferences and priorities of the information users and communities from which the data is sourced or which the data is about. An ISI strategy may delineate workforce needs and outline a skills development plan for informatics, leadership and other technology and data roles.

The term **affected parties** is used throughout the model. This term includes a broad range of individuals that are affected by the ISI decisions and activities throughout data processes. This may include but is not limited to PHA staff and team members, internal and external organizational leaders, legal, data exchange partners, researchers/academia, community health leaders, representatives and data stewards from key data sources, agency IT teams, contractors and representatives from the groups reflected in the data (e.g., patient advocates, community members, those with lived experience, etc.).

Scales

The following provides universal guidance for completing the WAI Maturity Model scales.

- Who should complete the WAI Maturity Model: The WAI maturity model should be completed by the PHA's ISI leader and/or key information systems improvement team members who understand information system improvement efforts at the PHA and the scope of ISI projects.
- Estimated completion time: We anticipate that completing the model will take respondents 1.5 to 2 hours to complete. Respondents are encouraged to complete the model based on the best, to-date knowledge they have about the PHA's information systems.
- Exercise the appropriate degree of consideration:
  - When scales include criteria that feel subjective or that could be achieved in various ways (e.g., regular evaluation or continuous improvement processes can take many

forms), use your existing knowledge of best practices and current understanding of your PHA activities to answer as you deem most fitting.
    - When scales include estimated proportions as a guide (e.g., "at least 50% of…"), respondents using the assessment can either take an informed, best-estimate approach in responding or use a more rigorous assessment of PHA systems to respond to the scales. The decision on your approach depends on the purpose of the model's use within your PHA.
- When Between Scale Levels: Criteria within scale levels elevate key aspects of maturity. Therefore, PHAs should only select a scale level if they meet all criteria within that scale level. In instances where your PHA may be between two scale levels and/or meet criteria in two scale levels, select the **lower** scale level.
- Using prior assessments: Results from prior information systems assessments might be used to inform WAI Maturity Model responses.
- Consider entire PHA: The scales seek to understand information systems maturity across **the entire PHA**, not just a single system or data set. **To the extent that you are able**, consider the entire scope of your PHA's information system activities when completing the scales.
- Definitions: **teal hyperlinks** throughout go directly to Appendix A to offer a definition.
- Some **notable limitations** to the model:
    - The model does not define a scale of maturity for data security due to the dynamisms of this area, although security considerations are represented in several scales.
    - The model does not include an "automation" capability. Automation is infused in other scales.
    - The model only asks about presence of the capability but not about whether the capability is within the PHA's scope to improve or if it is handled by another agency on behalf of the PHA.
- **Supplemental appendices** are included to support completion of the model:
    - Appendix A: Definitions
    - Appendix B: Governance Guide
    - Appendix C: Examples of Data Types
    - Appendix D: Crossover of PHDS Goals to WAI Maturity Model Capabilities
    - Appendix E: References and Additional Resources

Dimension 1: Information Systems Improvement (ISI) Strategy and Governance

The ISI Strategy and Governance dimension examines PHA capabilities related to creating and adopting an ISI vision and strategy and ISI governance policies, processes and procedures. The capabilities within this section were informed by PHII's Data Governance for Public Health Course.

1.1 Information Systems Improvement (ISI) Vision and Strategy [6]

Capability: The PHA's information system improvement activities are guided by a PHA-wide vision and strategy[7] that encompasses all major PHA information systems.

Scale:

- **Not Started**: No vision or strategy encompassing all major PHA information systems (i.e., PHA-wide vision and strategy) has been defined.
- **Ad Hoc and Individual**: A PHA-wide vision and strategy may be understood among those making decisions about the PHA's information systems but is not written and/or not informed by affected parties. PHAs within this category may have written strategies for individual systems or types of data but not a PHA-wide ISI vision and strategy.
- **Developing and Strategic**: The PHA is developing a PHA-wide ISI vision and strategy. This development is informed by feedback from affected parties. The planning process has leadership buy-in.
- **Standardized and Integrating:** The PHA has developed a PHA-wide ISI vision and strategy and is implementing the vision and strategy. The strategy has leadership buy-in and has been communicated to affected parties within the PHA. The PHA is in the early stages of using the ISI strategy to guide PHA information system decisions and project workplans (e.g., not all program teams may be familiar with and/or using the ISI strategy).
- **Ongoing Improvement and Full Integration:** The PHA has implemented significant portions of the ISI strategy. Most or all PHA information system decisions and project workplans are guided by the PHA-wide ISI vision and strategy. The PHA uses relevant and engaged approaches to periodically assess and evolve the ISI strategy with input from affected parties.

[6] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.
[7] The Public Health Informatics Institute (PHII). (2018). Accessed 08/16/24. "Building an Informatics-savvy Health Department: A Self-assessment Tool." https://phii.org/download/informatics-health-department-self-assessment-tool/

1.2 Information Systems and Data Governance [8,9,10]

Capability: The PHA has governance processes across all major PHA information systems and datasets that establish policies to guide operations, creating an environment where high quality information is available to inform timely decision making.

Within this scale, "information systems governance" encompasses systems, software and data governance. Policies and processes can address such things as access permissions to tools, data and information internally and externally; data access strategies; data quality; data standards; acquisition, development, implementation, maintenance and updates of systems and other resources; and more (for more examples, see Appendix B. Governance Guide).

Scale:

- **Not Started**: No active governance processes or protocols exist. The PHA is not currently developing governance processes or protocols.
- **Ad Hoc and Individual**: The PHA has some governance processes and policies, but they are informal, used very inconsistently and/or the processes do not engage affected parties. PHAs within this category may have written governance processes or protocols for individual systems, data types or program areas, but governance processes and protocols are not consistent across all major PHA systems.
- **Developing and Strategic**: The PHA is planning and/or piloting governance processes and protocols across all major PHA systems. This development is informed by feedback from affected parties. The PHA pilots use cases to build a foundation for further growth and enhancement.
- **Standardized and Integrating:** The PHA has established critical governance processes and protocols to apply across all major PHA systems and developed foundational documentation (e.g., charter, high priority process documents, policies, etc.). The governance processes and protocols have leadership buy-in, align with the ISI strategy's goals and have been communicated to affected parties within the PHA. The PHA is in the early stages of using the governance processes and protocols across all major PHA systems.
- **Ongoing Improvement and Full Integration:** The PHA has achieved the previous level, and PHA information system users use the governance processes and protocols about 90% of the time. The PHA uses relevant and engaged approaches to periodically assess adherence to and utility of the policies and procedures and evolve the policies and procedures with input from affected parties.

[8] The Public Health Informatics Institute (PHII). (2024). "Data Governance for Public Health." Accessed 08/08/24. https://phii.org/data-governance. Informed by this PHII Data Governance training.
[9] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Informed by PHII Question 1.3 Governance Process.
[10] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

1.3 Sustainable Funding

Capability: The PHA has a funding plan[11] for ISI – including but not limited to workforce, software, systems and related activities – and is effectively meeting ISI resource needs and developing sustainable funding.

Scale:

Note: This scale includes multiple components: having a funding plan *and* securing funding. If your PHA is further along in one of these components than the other, score your PHA based on the level of your least mature component.

- **Not Started:** The PHA does not have a funding plan[11] for its planned ISIs. The PHA has been unable to secure funds to move ISI activities forward.
- **Ad Hoc and Individual**: A general funding plan[11] is understood among those making decisions about the PHA's information systems but it is not written and/or was not developed with careful consideration of the ISI strategy's goals. The PHA may have ad hoc and/or sporadic funding for ISI activities.
- **Developing and Strategic**: The PHA has a funding plan[11] that aligns with the ISI strategy's goals. The PHA has initial funding streams such as short term grants or one-time allocations but these funds may not be sustainable or diversified, or ongoing funding may be clearly insufficient.
- **Standardized and Integrating**: The PHA has developed a funding plan.[11] The plan has leadership buy-in, aligns with the ISI strategy's goals and has been communicated to affected parties within the PHA. The PHA is in the early stages of using the plan to guide advancement activities for ISI. The PHA has at least one large, longer term (e.g., three or more years) funding source and has begun to diversify its funding sources.
- **Ongoing Improvement and Full Integration**: The PHA regularly uses its funding plan[11] to guide advancement activities for ISI. The PHA uses relevant and engaged approaches to periodically assess progress according to the funding plan and evolves the plan based on emerging information and updates to the ISI strategy. The PHA has secured large, longer term (e.g., three or more years) funding and diversified its funding sources (e.g., including agency core budget, grants, cooperative agreements, etc.).

[11] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/ The funding plan component included in this scale was added based on PHII Question 1.4 Funding Plan.

1.4 Future-facing and Scalable Information Systems [12]

Capability: The PHA intentionally develops information systems that accommodate future growth and evolving technologies (for example, by using national standards even when not yet integrating into national systems) – herein referred to as "accommodating future growth" – and that can be maintained long term within the PHA's expected resources – herein referred to as "maintained long term".

Scale:

Note: This scale includes multiple components: accommodating future growth *and* maintenance long term. If your PHA is further along in one of these components than the other, score your PHA based on the level of your least mature component.

- **Not Started:** The PHA faces severe challenges in considering ways information solutions can accommodate future growth and how they can be maintained long term.
- **Ad Hoc and Individual:** When implementing information solutions, the PHA may consider (a) ways to accommodate future growth and/or (b) maintaining solutions long term; however, the PHA faces challenges in identifying solutions that meet these criteria.
- **Developing and Strategic:** When implementing information solutions, the PHA sometimes deploys solutions that (a) accommodate future growth and/or (b) can be maintained in the near term (e.g., less than three years).
- **Standardized and Integrating:** When implementing information solutions, the PHA consistently deploys solutions that (a) accommodate future growth and (b) can be maintained for the next four to ten years.
- **Ongoing Improvement and Full Integration:** The PHA uses relevant and engaged approaches to periodically assess if there are opportunities to increase the ability of information solutions to accommodate future growth and assesses for upcoming challenges regarding maintenance of information solutions. The PHA evolves approaches based on emerging information.

[12] Capability included based on feedback from WAI Public Health Agencies during a 10/16/24 Insight Session with WAI PHAs.

Dimension 2: Workforce

The Workforce dimension examines the PHA's ability to recruit, hire and retain qualified staff and ensure access to qualified personnel with the diverse data and technology skillsets needed to pursue its ISI strategy and activities.

2.1 Recruitment of ISI Staff [13,14]

Capability: The PHA's human resources practices support recruitment and rapid hiring of highly qualified ISI staff.

Scale: Answer this scale as it relates to positions you seek to hire within the PHA itself.
Consider the following list of effective recruitment and hiring practices when answering the scale below:

1. Complete set of defined and readily available job descriptions and classifications for ISI staff structured into the organization.[15]
2. Recruitment approaches that reach ISI job candidates within and beyond public health, producing qualified candidate pools. This may include the use of external job boards, effective advertising of roles and beyond.
3. Competitive salary packages for ISI staff.
4. Competitive benefits packages (e.g., insurance, paid leave, parental leave) for ISI staff.
5. Ability to support effective and fully remote positions outside of the local jurisdiction.
6. Interview processes that allow the PHA to assure needed expertise (e.g., relevant questions, opportunities to probe, etc.).
7. Supportive recruitment staff with sufficient capacity and skillsets (e.g., technology recruiters) to support PHA hiring needs.
8. Consistent approaches that routinely seek feedback from new employees regarding the hiring process and use the feedback to create more robust recruitment approaches.

Based on the above list of eight (8) recruitment and hiring practices, assess your PHA on the scale below:

- ☐ **Not Started:** The PHA has none of these practices well established and is not making progress on any of these practices. The PHA is unable to hire PHA ISI staff even when needed.
- ☐ **Ad Hoc and Individual:** The PHA has one or two of these practices well established and is not making progress on any others. The PHA faces severe challenges in hiring qualified ISI staff (e.g., roles remain vacant for more than nine months to a year).
- ☐ **Developing and Strategic:** The PHA has at least two of these practices well established with at least two others in development. The PHA cannot quickly hire qualified ISI staff (e.g., roles remain vacant for more than six months to nine months).
- ☐ **Standardized and Integrating**: The PHA has four of the practices well established with at least two others in development. The PHA can hire qualified ISI staff within six months.

[13] Pearsol J, Budzinski A, Nanthavongsa-Mosley A., Myers L, Zialcita M. (2024). Optimizing Governmental Public Health Recruitment and Hiring. Journal of Public Health Management and Practice 30(5):p 765-771, September/October 2024. DOI: 10.1097/PHH.0000000000002030.
[14] Scale components refined for ISI space based on interview with CDC Foundation human resources and feedback from WAI PHAs at 10/16/24 Insight Session.
[15] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Aligns with PHII Question 2.2 Job Classifications for Informatics Positions.

- **Ongoing Improvement and Full Integration**: The PHA has at least 6 of the practices well established (with 1 of these being practice #8) and others may be in development. The PHA can hire qualified ISI staff in less than 4 months.

2.2 Retention of ISI Staff [16,17]

Capability: The PHA's human resources (HR) practices facilitate an environment where the PHA can retain high-performing ISI staff.

Scale: Answer this scale as it relates to positions you have hired within the PHA itself.
Consider the following list of effective retention practices when answering the scale below:

1. Defined opportunities (e.g., annual performance reviews) where high-performing ISI staff can be awarded raises and/or promotions.
2. Support for flexible work arrangements (e.g., hybrid, asynchronous hours).
3. Helpful, effective and responsive supervisors, management, leadership, HR and benefits teams.
4. Supportive culture that promotes work-life balance.
5. Approaches to ensure employees feel connected with colleagues and invested in achieving the organizational mission.
6. Transparent career development and advancement pathways.
7. Training opportunities and funding support, including leadership, management and ISI skills.[18]
8. Practices beyond performance reviews to recognize and acknowledge employee accomplishments and contributions.
9. Consistent approaches that routinely seek feedback from employees regarding their job satisfaction and use the feedback to create more responsive HR and management policies and practices.

Based on the above list of nine (9) retention practices, assess you PHA on the scale below:

- **Not Started:** The PHA has none of these practices well established and is not making progress on any of these practices. On average, the PHA is unable to retain high-performing PHA ISI staff for more than six months.
- **Ad Hoc and Individual:** The PHA has one to three of these practices well established and is not making progress on any of the others. On average, the PHA retains most high-performing PHA ISI staff for about a year.
- **Developing and Strategic:** The PHA has at least three of these practices well established with at least two others in development. The PHA can retain most high-performing staff for one or two years but faces notable challenges in retaining ISI staff for more than two years.
- **Standardized and Integrating**: The PHA has at least five of the practices well established with at least two others in development. The PHA can retain most high-performing ISI staff for two to four years.

[16] Khalid O, Myers L, Baddour L, Williams A. Strategies for Enhancing Governmental Public Health Workforce Well-being and Retention. Journal of Public Health Management and Practice 29(4):p 601-603, July/August 2023. DOI: 10.1097/PHH.0000000000001770.
[17] Scale components refined for ISI space based on interview with CDC Foundation human resources and feedback from WAI PHAs at 10/16/24 Insight Session.
[18] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Aligns with PHII Question 2.3 Training.

- **Ongoing Improvement and Full Integration**: The PHA has at least seven of the practices well established (with one of these being practice #9) and others may be in development. The PHA can retain high-performing ISI staff for more than four years.

2.3 Access to Sufficient and Diverse ISI Skillsets [19,20]

Capability: The PHA has readily accessible technology and data personnel – including internal staff, contractors, centralized IT team members and others – with the necessary "hard" and "soft" skills and availability to make progress on its ISI strategy.

Scale:

- **Not Started**: The PHA has not been able to secure technology and data personnel to make progress on its ISI strategy.
- **Ad Hoc and Individual**: The PHA has a few readily accessible technology and data personnel; however, the individuals do not have the right qualifications and skills to make meaningful progress on the PHA's ISI strategy.
- **Developing and Strategic**: The PHA has some readily accessible technology and data personnel with the right qualifications and skills; however, there is an insufficient number of these personnel and/or the personnel do not have sufficient capacity to make measurable progress on the PHA's ISI strategy
- **Standardized and Integrating:** The PHA has readily accessible technology and data personnel with the right qualifications and skills. The PHA has sufficient personnel with enough capacity to make measurable progress on its ISI strategy.
- **Ongoing Improvement and Full Integration:** In addition to achieving the previous level, the PHA periodically assesses the need for new or enhanced skillsets across technology and data personnel and plans approaches to procure these skills.

[19] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Adapted from PHII Question 2.4 Informatics Professionals.
[20] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

2.4 PHA Staff Information Systems Knowledge [21,22]

Capability: The PHA's management teams (including project managers, supervisors, directors, etc.) and leadership have the appropriate level of knowledge needed to fulfill their responsibilities related to ISI. The PHA's program staff have sufficient skillsets to effectively use available information solutions.

Scale:

Note: This scale includes multiple components: knowledge among leadership, management team members *and* PHA's program staff. If your PHA is further along in one of these components than the other, score your PHA based on the level of your least mature component.

- **Not Started**: The PHA's program staff, management teams and leadership have been unable to gain sufficient knowledge or skills to effectively fulfill their ISI responsibilities or effectively use information solutions.
- **Ad Hoc and Individual**: A few PHA management and leadership team members (e.g., <20%) have sufficient knowledge to fulfill their ISI responsibilities. A few of the PHA program staff (e.g., <20%) have sufficient skills to effectively use available information solutions.
- **Developing and Strategic**: Some PHA management and leadership team members (e.g., <50%) have sufficient knowledge to fulfill their ISI responsibilities. Some PHA program staff (e.g., <50%) have sufficient skills to effectively use available information solutions.
- **Standardized and Integrating:** A majority of PHA management and leadership team members (e.g., >50%) have sufficient knowledge to fulfill their ISI responsibilities. A majority of PHA program staff (e.g., >50%) have sufficient skills to effectively use available information solutions.
- **Ongoing Improvement and Full Integration:** Almost all PHA management and leadership team members (e.g., >90%) have sufficient knowledge to fulfill their ISI responsibilities. Almost all PHA program staff (e.g., >90%) have sufficient skills to effectively use available information solutions. The PHA uses relevant and engaged approaches to periodically assess the need for new or enhanced skillsets across staff and plans approaches to procure these skills through training or hiring.

[21] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Adapted from PHII Questions 2.5 Informatics Knowledge and Skills (Program Level) and 2.6 Informatics Knowledge and Skills (Program Managers).
[22] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

2.5 Systems Improvement Leadership [23]

Capability: The PHA has employed a leader (or shared leadership) with sufficient time, longevity, experience and influence to direct ISI activities across the PHA and ensure ongoing progress.

*The ISI leader(s) is responsible for driving the ISI strategy forward, including understanding and advocating for the goals of the ISI; assuring that PHA staff develop the appropriate **informatics** skillsets; informing and guiding ISI decisions made by programs, ISI staff and leadership; assuring sustainable funding; and ultimately assuring **affected parties** have access to high quality data to make decisions impacting health and wellbeing. An example could be the Data Modernization Initiative (DMI) Director.*

Scale:

- **Not Started**: The PHA does not have an ISI leader and is not currently able to prioritize identifying an ISI leader.
- **Ad Hoc and Individual**: The PHA does not have an ISI leader. The PHA would like to identify an ISI leader; however, the PHA has not done so and/or could be in the search process.
- **Developing and Strategic**: The PHA has identified an ISI leader (or shared leadership) that oversees ISI activities across the PHA; however, the ISI leader(s) may face limitations in fulfilling their role.

  Reasons for limitations in fulfilling the role include: insufficient allocation (e.g., less than 25% of their work hours allocated to the role or shared leadership), being a contractor, being a new hire (e.g., need time to get acclimated to the PHA context), not having the right skillset, sufficient experience and/or insufficient influence to advocate for ISI prioritization and funding with PHA or agency leadership.
- **Standardized and Integrating:** The PHA has an ISI leader (or shared leadership) who is employed by the PHA with at least 25% of their work hours allocated to ISI leadership. The ISI leader(s) meets at least two out of the following: (a) been in the role for at least two years, (b) is qualified for the role and/or (3) has sufficient influence to assure ISI strategy prioritization and budget with PHA or agency leadership.
- **Ongoing Improvement and Full Integration:** The PHA has an ISI leader (or shared leadership) who is employed by the PHA with at least 50% of their work hours allocated to ISI leadership. The ISI leader(s) meets all the following: (a) has been in the role for at least two years, (b) is qualified for the role and (c) has sufficient influence to assure ISI strategy prioritization and budget with PHA or agency leadership.

[23] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

Dimension 3: Partnerships and Networks

The Partnerships and Networks dimension examines the PHA's ability to maximize collaboration between PHA program staff, ISI project staff and agency IT teams in meeting ISI strategy goals and the PHA's engagement in the broader public health ISI ecosystem outside the PHA.

3.1 Information Systems Improvement, Program and IT Coordination [24]

Capability: The PHA's ISI projects and efforts are coordinated with PHA program staff and the agency IT team to build efficient systems, improve utility and maximize adoption.

Scale:

- **Not Initiated**: The PHA ISI projects face major barriers in coordinating with PHA program staff or the agency's IT team.
- **Ad Hoc and Individual**: The PHA's ISI projects may be coordinated with PHA program staff or the agency IT team, but the engagements are informal, not well organized and/or inconsistent with no established protocols on how ISI project contributors, PHA program staff and/or IT should be engaged.
- **Developing and Strategic**: The agency is collaboratively developing and/or piloting coordination protocols for PHA ISI projects including when and how ISI project, PHA program and IT staff should be engaged, the roles/responsibilities of each, decision-making processes and service expectations.
- **Standardized and Integrating**: The PHA has developed coordination protocols to apply across PHA ISI projects. The protocols have leadership buy-in and have been communicated to ISI project, programs and IT staff. ISI projects are in the early stages of routinely using the coordination protocols.
- **Ongoing Improvement and Full Integration**: The PHA has achieved the previous level, and ISI projects use the coordination protocols at least 90% of the time. The PHA periodically assesses adherence to and utility of the protocols and strength of coordination across ISI project, program and IT staff, and evolves the protocols using input from these groups.

[24] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Informed in part by PHII Question 1.10 Centralized IT and Informatics.

3.2 External Public Health Data Community Networking

Capability: The PHA is an active contributor within the broader national network of public health professionals, agencies and partners.

PHAs that are more engaged may be better able to: rapidly understand emerging technologies and trends, capitalize on emerging funding opportunities, partner with organizations that can support their systems improvement efforts, connect with peers who can provide mentorship and troubleshooting support and assure that national strategies and standards address their needs.

Scale:

- **Not Started:** The PHA team is unaware of and/or unable to connect with the broader discussions around data modernization, the CDC's Public Health Data Strategy (PHDS) and emerging technology opportunities.
- **Ad Hoc and Individual:** The PHA team is aware of national conversations around the PHDS and related data modernization initiatives (herein referred to as DMI), but do not formally engage in any DMI working groups, funding opportunities or national associations.
- **Developing and Strategic:** PHA staff may receive regular emails or communications about DMI and join webinars and presentations. The PHA is not formally engaged in DMI working groups or national associations.
- **Standardized and Integrating:** The PHA takes an active role in the DMI community by sending PHA staff to DMI conferences, seminars, convenings, trainings, etc.; at least 20% of PHA ISI staff sit on at least 1 cross-organizational group or committee related to DMI. Some of the PHA's ISI staff have connections with others outside the PHA in the DMI space (e.g., related staff at other PHAs or national organizations).
- **Ongoing Improvement and Full Integration:** Some PHA staff take on very active roles within the DMI community by presenting at conferences or convenings; leading trainings or webinars; releasing tools and resources; and leading cross-organizational working groups or committees. PHA ISI staff in varied roles have connections with others in the DMI space, possibly meeting with them to share insights and troubleshoot.

Dimension 4: Technical Capabilities

The Technical dimension examines the extent to which the PHA can take advantage of technology to enable real-time data that support mission-critical PHA functions. Examples of data types to consider for this dimension are listed in Appendix C and Appendix D maps how these technical capabilities align to CDC's PHDS goals.

4.1 System Acquisition and Enhancements

Capability: The PHA uses a consistent process to plan, design, implement, maintain and enhance information systems. The process uses effective approaches that engage affected parties, employ user-centered design, ensure system acquisition is done at the organizational level (versus within particular programs or projects) and create alignment with the PHA's ISI strategy.

Scale:

Note: This scale includes multiple components: defining a consistent process *and* the level of PHA self-reliance to make ISI decisions. If your PHA is further along in one of these components than the other, score your PHA based on the level of your least mature component.

- **Not Started**: No process for selection or design of new systems or system enhancements has been defined. The PHA does not have sufficient experience to evaluate system improvement options internally and heavily relies on external vendor input to make decisions.
- **Ad Hoc and Individual**: A consistent process may be understood among some PHA staff or programs but it is not written and/or informed by affected parties. PHAs within this category may have some projects that use a defined process but this process is not consistent across the PHA. A few PHA staff may have sufficient experience to evaluate system improvement options internally; however, many still rely on external vendor input to make decisions.
- **Developing and Strategic**: The PHA is developing and/or piloting a consistent process that uses effective approaches. The planning process has leadership buy-in. PHA leaders of ISI projects and a few relevant PHA staff have sufficient experience to evaluate system improvement options internally and the PHA relies only moderately on external vendor input to make decisions.
- **Standardized and Integrating**: The PHA has developed a consistent process that uses effective approaches. The strategy has leadership buy-in and has been communicated to affected parties within the PHA. The PHA is in the early stages of using the process (e.g., not all program teams may be familiar with and/or using the process). PHA leaders and staff on ISI projects have ample experience to evaluate system improvement options internally and while they consider external vendor input, they do not rely on it for decisions.
- **Ongoing Improvement and Full Integration**: The PHA has achieved the previous level and almost all PHA teams use the process at least 90% of the time. The PHA uses relevant and engaged approaches to periodically assess adherence to and utility of the process and to evolve with input from affected parties.

4.2 Interoperability: Extent of External Electronic Data Exchange [25]

Capability: The PHA effectively sends and/or receives electronic data to/from external partners, such as healthcare entities, laboratories, state or local health information exchanges, other PHAs, Tribal Epidemiology Centers, Tribes, technology partners, community organizations, etc.[26]

Scale:

Note: This scale includes multiple components: number of external partners *and* number of data types. If your PHA is further along in one of these components than the other, score your PHA based on the level of your least mature component.

- **Not Started**: The PHA does not send any data to and/or receive any data from any external partners.
- **Ad Hoc and Individual**: The PHA only sends and/or receives non-electronic data, such as via email, paper, phone calls or fax.
- **Developing and Strategic (Early)**: The PHA sends and/or receives electronic data with one or two external partners.
- **Developing and Strategic (Mature)**: The PHA sends and/or receives electronic data with three to five external partners and may send and/or receive electronic data for more than one data type.
- **Standardized and Integrating:** The PHA sends and/or receives electronic data with three or more external partners and for two or more data types.
- **Ongoing Improvement and Full Integration**: The PHA routinely sends and/or receives electronic data for all major data types where electronic data exchange is appropriate. The PHA periodically assesses the effectiveness and efficiency of data exchange and collaborates with PHA and partner staff to improve data exchange over time.

[25] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

[26] Data may be about persons, materials, location or other entities, at an individual or summarized level, with or without person identifiers. Data that is electronically shared may or may not require some manual effort. The extent of automation and sophistication of data exchange is assessed in subsequent WAI Maturity Model interoperability capabilities.

4.3 Interoperability: External Exchange Message Format [27,28]

Capability: In recurring external data exchanges, information to be captured in electronic databases is transferred in standard message formats that simplify the ingestion of that data into those databases, using national standards where such standards exist.

Scale:
Select the highest level on the scale that applies to the statement: "For **at least half** of the data sources we exchange externally, we are at the <<fill in with one of the scale levels described below>> level or higher."

- **Not Started:** The PHA does not send any data to and/or receive any data from any external partners.
- **Ad Hoc and Individual (Early):** The PHA sends and/or receives data to/from external partners on paper or scanned images with inconsistent layouts, requiring manual "keypunch" entry into electronic databases.
- **Ad Hoc and Individual (Mature):** The PHA sends and/or receives data to/from external partners on paper or image in consistent, scannable formats.
- **Developing and Strategic:** The PHA sends and/or receives data to/from external partners as electronic data records; however, the PHA does not use a standard message format or standardized field content, and there may be variation in approaches across the PHA.
- **Standardized and Integrating (Early):** The PHA sends and/or receives data to/from external partners as electronic data records and uses (a) a standard message format.
- **Standardized and Integrating (Mature):** The PHA sends and/or receives data to/from external partners as electronic data records and uses (a) a standard message format and (b) standardized field content.
- **Ongoing Improvement and Full Integration:** The PHA sends and/or receives data to/from external partners as electronic data records and uses (a) a standard message format, (b) standardized field content and (c) national standards where they exist (e.g., HL7, LOINC, SNOMED, etc.). The PHA periodically assesses the effectiveness and efficiency of data exchange and collaborates with PHA and partner staff to improve data exchange over time.

[27] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Exchange Content."
[28] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

4.4 Interoperability: External Exchange Mode [29,30]

Capability: In recurring external data exchanges, data is electronically sent to and/or received from external partners in a timely, automated and monitored manner.

Scale:
Select the highest level on the scale that applies to the statement: "For **at least half** of the data sources we exchange externally, we are at the <<fill in with one of the scale levels described below>> level or higher."

- ☐ **Not Started:** The PHA does not send any data to and/or receive any data from any external partners.
- ☐ **Ad Hoc and Individual (Early):** The PHA sends and/or receives data to/from external partners using inconsistent manual processes (e.g., fax or email) that may vary from one exchange to the next.
- ☐ **Ad Hoc and Individual (Mature):** The PHA sends and/or receives data to/from external partners using consistent, manual processes (e.g., fax or email) that do not vary from one exchange to the next.
- ☐ **Developing and Strategic (Early):** The PHA sends and/or receives data to/from external partners using partially automated processes (e.g., manually starting a transfer or manual review of each automated download).
- ☐ **Developing and Strategic (Mature):** The PHA sends and/or receives data to/from some external partners using secured data streams (e.g., HTTPS or SFTP) or automated functions (e.g., via APIs, called services or integration engines).
- ☐ **Standardized and Integrating:** The PHA sends and/or receives data to/from most external data exchange partners using secured data streams and a highly automated process with good monitoring of connections (e.g., for notable changes in the size or frequency of exchanges), at a frequency appropriate to the data used.
- ☐ **Ongoing Improvement and Full Integration:** The PHA has achieved the previous level, plus uses national standards where they exist (e.g., FHIR APIs). The PHA periodically assesses the effectiveness and efficiency of data exchange and collaborates with PHA and partner staff to improve data exchange over time.

[29] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Exchange Mode and Automation."
[30] Centers for Disease Control and Prevention (CDC). (2022). Accessed 07/12/24. "Data Modernization Assessment Worksheet v.1.0."

4.5 Interoperability: Degree of Data Integration (External) [31, 32, 33]

Capability: Data from external system(s) are seamlessly integrated into internal PHA system(s) in ways that support staff workflow and provide important value.

Scale:

Select the highest level on the scale that applies to the statement: "For **at least half** of the data sources integrated into our systems from external sources, we are at the <<fill in with one of the scale levels described below>> level or higher."

Apply the following scale to the data type(s) and/or system(s) **impacted by the work of WAI Placements**.

- **Not Started:** The PHA does not receive any data from external partners or the PHA receives data but it is integrated in a way that makes it very difficult for internal PHA system users to access and use.
- **Ad Hoc and Individual:** The PHA receives data from external partners but it requires manual data re-entry or other manual processes to be used (e.g., a flat file may be shared and then manually analyzed or manually input into internal systems). A few internal PHA system users can use the data; however, the data may not be used in many staff workflows where it could provide important value.
- **Developing and Strategic:** The PHA receives data from external partners electronically. Data re-entry is not necessary, but some manual intervention is required (e.g., starting a transfer or loading a data set) for internal systems to integrate the data. Some internal PHA system users can use the external data as part of their routine workflows; however, there may still be notable limitations to the utility of that data (e.g., time lags, data quality issues or staff do not know how to use the data).
- **Standardized and Integrating:** The PHA's systems automatically ingest and integrate external data through automated processes. Many PHA staff use the integrated data within their regular workflows. The data is timely, accurate and complete.
- **Ongoing Improvement and Full Integration:** The PHA has achieved the previous level, and all appropriate PHA staff use the integrated external data within their regular workflows at least 90% of the time. The PHA periodically assesses the effectiveness and efficiency of integration processes and collaborates with PHA and partner staff to improve integration over time.

[31] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Data Ingestion and Integration" and "Capability: Interoperability."
[32] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Scale informed by PHII Question 3.7 Data Exchange (External).
[33] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

4.6 Interoperability: Internal Exchange Mode [34,35]

Capability: In recurring data exchanges between internal PHA systems, data is electronically sent and received in a timely, automated and monitored manner.

Scale:
Select the highest level on the scale that applies to the statement: "For **at least half** of the data sources we exchange between internal systems, we are at the <<fill in with one of the scale levels described below>> level or higher."

- **Not Started:** The PHA's internal systems do not exchange any data.
- **Ad Hoc and Individual (Early):** The PHA's internal systems exchange data using inconsistent manual processes (e.g., manually re-entering data) without standard protocols.
- **Ad Hoc and Individual (Mature):** The PHA's internal systems exchange data using consistent, manual processes (e.g., manual copying or reentry) guided by standard protocols.
- **Developing and Strategic (Early):** The PHA's internal systems exchange data using partially automated processes (e.g., manually starting a transfer or manual review of each automated download).
- **Developing and Strategic (Mature):** The PHA's internal systems automatically exchange data and interact though automated functions (e.g., via APIs or automated backend database queries).
- **Standardized and Integrating:** The PHA's internal systems automatically exchange data through a highly automated process with good monitoring of connections (e.g., for notable changes in the size or frequency of exchanges), at a frequency appropriate to the data used.
- **Ongoing Improvement and Full Integration:** The PHA has achieved the previous level, plus the PHA periodically assesses the effectiveness and efficiency of data exchange and collaborates with PHA staff to improve data exchange over time.

[34] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Exchange Mode and Automation."
[35] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

4.7 Interoperability: Degree of Data Integration (Internal) [36, 37,38]

Capability: Data is seamlessly exchanged and integrated across internal systems in ways that support staff workflow and provide important value.

Scale:

Select the highest level on the scale that applies to the statement: "For **at least half** of the data sources we exchange externally, we are at the <<fill in with one of the scale levels described below>> level or higher."

- **Not Started:** The PHA's internal systems do not exchange any data or the systems are integrated in a way that makes it very difficult for PHA staff to access and use.
- **Ad Hoc and Individual:** The PHA's internal systems exchange data but it requires manual data re-entry or other manual processes to be used (e.g., a flat file may be shared and then manually analyzed or manually input into internal systems). A few internal PHA system users can use the data; however, the data may not be used in all staff workflows where it could provide important value.
- **Developing and Strategic:** The PHA's internal systems exchange data electronically. Data re-entry is not necessary, but some manual intervention is required (e.g., starting a transfer or loading a data set) for internal systems to integrate the data. Some internal PHA system users can use the data from other internal systems as part of their routine workflows; however, there may still be notable limitations to the utility of that data (e.g., time lags, data quality issues or staff do not know how to use the data).
- **Standardized and Integrating:** The PHA's systems automatically ingest and integrate data from other internal systems through automated processes. Many PHA staff use the integrated data within their regular workflows. The data is timely, accurate and complete.
- **Ongoing Improvement and Full Integration:** The PHA has achieved the previous level, and all appropriate PHA staff use the integrated data from other internal systems within their workflows at least 90% of the time. The PHA periodically assesses the effectiveness and efficiency of integration processes and collaborates with PHA staff to improve integration over time.

[36] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Data Ingestion and Integration" and "Capability: Interoperability."
[37] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Scale informed by PHII Question 3.6 Data Exchange (Internal).
[38] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

4.8 Centralizing Common Organizational Functions [39,40]

Capability: The PHA uses one tool for similar functions across the PHA's programs and administrative activities (e.g., client registration, billing, analysis, data sharing, master patient indexes and so forth).

Scale:

Apply the following scale to the **entire PHA**.

- **Not Started**: The PHA's individual departments or programs (herein referred to as units) use unit-specific tools and/or software to carry out similar functions.
- **Ad Hoc and Individual**: The PHA has not started coordinated or centralized efforts to migrate to PHA-wide tools and software. The PHA may use some of the same tools and software to conduct similar functions across some units; however, there is still high variation in tools and software used across the PHA.
- **Developing and Strategic**: The PHA is developing a strategy to migrate to PHA-wide tools for high priority, cross-cutting functions. Feedback from affected parties informs the PHA's planning.

  PHAs early in this level may still use various tools and software across the PHA. However, by the latter part of this level, the PHA will be leveraging piloting efforts to build a foundation for future tools or in the early stages of implementing a few critical PHA-wide tools.
- **Standardized and Integrating**: The PHA has developed a strategy and is implementing the strategy across high-priority organization-wide tools and software. The PHA has communicated and trained PHA team members on using the tools and software. Many PHA units use the same tools and software to conduct similar functions (e.g., not all units may be using the same tools for similar functions yet).
- **Ongoing Improvement and Full Integration:** The PHA has implemented its high-priority organization-wide tools and software. Almost all PHA units use the same tools and software to conduct the same functions at least 90% of the time. The PHA uses relevant and engaged approaches to periodically assess and evolve the organization-wide tools and software with input from affected parties.

[39] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Enterprise-wide Functions."
[40] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

4.9 Data Linkage and Deduplication [41,42]

Capability: The PHA can link related data together to provide more complete, accurate information for data users.

For example, PHAs can link birth and death certificate data, death certificates to communicable disease reports, immunization data to communicable disease reports, sexually transmitted infection data to social determinants of health data and so forth. Disease information from multiple sources about the same case are linked, rather than creating duplicate cases.

Scale:

Apply the following scale to the **entire PHA**.

- **Not Started**: External data sources, as well as internal data from PHA business units or programs, do not have unique record, person or place identifiers.
- **Ad Hoc and Individual (Early)**: Data have appropriate record or entity identifiers. Related records are not linked across data sources.
- **Ad Hoc and Individual (Mature)**: The PHA has some capability to match records across data sets or to de-duplicate records. That work is time consuming and requires significant manual effort.
- **Developing and Strategic**: The PHA uses automated processes to match records; however, there is still a large portion of incorrect or missed matches, requiring much follow-up effort to produce an acceptably accurate linked data set.
- **Standardized and Integrating**: The PHA has good capability to match records across data sets and to de-duplicate records in its most important datasets, producing acceptably accurate linked data sets, using advanced matching algorithms, a master patient index or other automated tools.
- **Ongoing Improvement and Full Integration**: The PHA has achieved the previous level, plus processes are implemented that assess the match quality at appropriate intervals and continue to improve the matching algorithm.

[41] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Data Linkages."
[42] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

4.10 Data Management and Quality [43,44]

Capability: The PHA applies effective data management practices to ensure data are well organized, accurate, timely and trustworthy for analysis and decision making.

Scale:

Apply the following scale to the **entire PHA**. *Consider the following list of effective data management and quality components:*

1. Minimizing the number of database management systems (DBMS) used to store data.
2. Having and maintaining organized meta-data (such as data, application and information systems inventories,[45] data dictionaries and other meta-data about almost all data sets).
3. Storing data in computer-readable electronic formats.
4. A single access method or portal to almost all data sets, providing a simplified, centralized way for users to access data (for example, data warehouse, data lake, single point of access into multiple platforms [SQL], etc.).
5. Consistent encoding of information across systems and data sets, employing standards set by the PHA, using national standards where such standards exist.
6. Periodic, systematic data quality checks and data improvement processes enhance data accuracy, completeness and utility.
7. Audit logs or other mechanisms for tracking data changes across data sets.

Based on the above list of seven (7) data management and quality components, assess your PHA on the scale below:

- ☐ **Not Started:** The PHA has none of these components in place and is unable to make progress on any of these components.
- ☐ **Ad Hoc and Individual:** The PHA is taking early steps to develop some of these components; however, no components are well established yet.
- ☐ **Developing and Strategic (Early):** The PHA has at least one of the components well established with at least two others in development, or at least three of the components are moderately established.
- ☐ **Developing and Strategic (Mature):** The PHA has at least three of the components well established with at least two others in development, or at least five of the components are moderately established.
- ☐ **Standardized and Integrating**: The PHA has at least five of the components well established with the remaining two in development, or all the components are moderately established in ways that simplify use of the data.
- ☐ **Ongoing Improvement and Full Integration**: The PHA has all components well established with relevant and engaged processes to periodically assess effectiveness of components in creating organized, accurate, timely and trustworthy data.

[43] Scale adapted from National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Data Management."
[44] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.
[45] The Public Health Informatics Institute (PHII). (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/. Scale item aligns with PHII Question 3.3 Information Systems Inventory.

4.11 Effective Use of Data Findings [46,47]

Capability: The PHA routinely analyzes and interprets data, making findings (i.e. information) accessible to internal and external information users in effective ways. Information users include PHA colleagues and leadership, policymakers, communities, researchers and other decision makers who use public health information to make decisions and pursue action.

Scale:

Apply the following scale to the **entire PHA**.

Note: This scale includes multiple components: making information accessible internally *and* externally. If your PHA is further along in one of these components than the other, score your PHA based on the level of your least mature component.

- **Not Started**: Data is not analyzed and/or interpreted and thus, little information is created that could better inform decisions.
- **Ad Hoc and Individual (Early)**: Internal PHA teams sometimes analyze and interpret data and produce findings (i.e., information) that can support information users. Information mostly remains within the unit or program where the analysis was conducted and is not readily available to other staff or the public.
- **Ad Hoc and Individual (Mature)**: Internal PHA teams routinely analyze and interpret data and produce findings (i.e., information) that could support information users. Information is shared internally in static formats (e.g., reports, emails, other publications) that include data visualizations (e.g., charts or graphs). Information may not be shared in a timely manner.
- **Developing and Strategic (Early)**: The PHA has achieved the previous level. In addition to sharing internally, PHA teams regularly share information publicly in reports and possibly other static products (e.g., briefs, social media, articles) that include data visualizations (e.g., charts or graphs). Information may still not be shared in a timely manner.
- **Developing and Strategic (Mature)**: The PHA has achieved the previous level. The PHA shares information in a timely manner internally and externally in static and dynamic formats (e.g., internal and public-facing dashboards or similar formats, data request processes, etc.).
- **Standardized and Integrating**: The PHA has achieved the previous level. The PHA implements practices to make its timely and dynamic public-facing data dashboards more likely to be used (e.g., communications to amplify information availability, meeting accessibility standards, using plain language, enhancing the user experience). The PHA has begun implementing metrics to assess the level of use and utility of the information among different information user groups.
- **Ongoing Improvement and Full Integration**: The PHA has achieved the previous level. The PHA uses metrics and engaged approaches to assess and improve the utility of information for internal and external information users, including aspects such as relevance, timeliness, format, clarity, trustworthiness and value. The information is interpreted in a way that reflects lived experiences and realities.

[46] Scale informed by National Association of County and City Health Officials (NACCHO) Informatics Workgroup. (2013). Information capabilities item, "Capability: Security."
[47] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

Appendix A. Definitions

Definitions Used Throughout

Public Health Agency/Authority (PHA): public health agencies or authorities (PHAs) are defined as organizations that are state, local, tribal or territorial entities that have governmental public health authority and conduct routine public health functions.

Informatics: informatics involves processing, managing and analyzing information through computational methods and systems. The Public Health Informatics Institute (PHII) defines public health informatics as "…the discipline that supports the effective use of information and information technology to improve public health practice and population health outcomes."[48]

Information Systems Improvement Strategy and Governance Definitions

Leadership Buy-in may include PHA/parent agency leadership endorsement of the vision and strategy; the addition of the vision and strategy into broader PHA strategic planning documents; allocating budget towards implementation of the strategy and/or other indicators of leadership prioritization.

Steps may include hiring a dedicated ISI leader and/or staff; purchasing software and other systems components; securing agreements with key partners, consultants or contractors; promoting staff upskilling through training and other tools; and/or developing project management plans.

Governance Process: "…How decisions are made and approved. This may include a written plan which describes who participates in decision making, a governance structure such as a committee, descriptions of how decisions are made and who has approval authority for what levels of decisions."[48] Governance processes may produce decisions about things like data access (internal and external), security, quality, standards, technology or workflow.

Systems Governance: the policies, processes and oversight mechanisms that manage and control an organization's IT systems and infrastructure.

Software Governance: software governance is a key component of overall systems governance. It entails the policies, processes and oversight mechanisms that manage software applications and development processes, including off-the-shelf software and custom-developed applications.

Data Governance: data governance is another key component of overall systems governance particularly relevant to public health (hence, it being called out specifically). Simply put by PHII, data governance is "…the people, policies, procedures and technologies that support how data are used and protected." PHA data assets include surveillance datasets, program evaluation data, administrative data and so forth.[48]

For more robust definitions of the following terms refer to the Governance Guide below.

Funding Plan: plan for sustaining information systems improvements that "…describes revenue goals and includes measurable objectives or benchmarks, as well as action steps related to the funding strategy. It may also include an analysis of the financial, physical facility and human resources (both staff and volunteer) needs."[48]

[48] The Public Health Informatics Institute. (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/

Workforce Definitions

Information Systems Improvement Job Descriptions (JDs): job classifications, including position descriptions and pay scales, for ISI positions – particularly those in informatics. These JDs define competencies, duties and minimum requirements in ways that clearly distinguish them from IT classifications.[48]

PHA Program Staff: individual departments, units or teams across the PHA that are responsible for a wide range of local public health activities, from managing disease prevention programs, to identifying emerging health threats, to engaging with communities, to reporting on health needs and so forth. PHA programs teams often include a range of skillsets, from epidemiology to community health interventionists to public health nurses to grants management and beyond.

Technology and Data Personnel: individuals with the knowledge, skills and experience to lead information system strategizing, implementation and policy development. Within WAI, technology and data staff roles include:

- Business Analyst
- Data Engineer
- Data Governance Specialist
- Data Scientist
- DevOps Engineer
- DM Senior Advisor
- Product Manager
- Project Implementation Manager/Informatics Project Manager
- Software Developer/Engineer
- Cybersecurity Specialist
- Systems Architect

Management Teams (includes roles like project managers, supervisors, directors and other leadership that may report up to a DMI lead): individuals leading or overseeing ISI projects as part of their role. To manage a well-functioning team that meets ISI milestones, this group must have sufficient knowledge and/or experience related to information systems and informatics to have reasonable expectations for system development, performance, IT support and so forth.[49]

Technology Definitions

Electronic data exchange refers to the electronic sending or receiving data so that the recipient may put that data into an electronic system for further use. Electronic exchange may or may not require some manual effort; however, it should not require manual keypunching of data into destination systems.

Electronically exchanged data may be about persons, events, materials, location or other things. It might be raw data at an individual level (e.g., person level records, individual laboratory results, water quality measurements, etc.) or aggregated (e.g., bed counts or case counts sent as data set records, etc.), with or without person identifiers.

> ***What it is not:*** Electronic data exchange does <u>not</u> include the electronic transmission of documents or files used to convey information to end users (e.g., data sent as reports, or in formats designed to be final summaries, such as reports that may be posted on a website

[49] The Public Health Informatics Institute. (2019). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. https://phii.org/download/informatics-health-department-self-assessment-tool/

for public consumption). *Conveying information to end users is considered in WAI Maturity Model capability 4.11, Effective Use of Data Findings.*

External and internal electronic data exchange:

External electronic data exchange involves the exchange of data with an entity outside of or a system owned and managed outside of the PHA, for example healthcare entities, laboratories, state or local health information exchanges, other PHAs, Tribal Epidemiology Centers, Tribes, technology partners, community organizations, etc.

Internal electronic data exchange involves the exchange of data between internally owned PHA systems.

Responding to WAI Maturity Model capability scales: Capability 4.2 is an overarching scale asking PHAs to consider all data electronically shared externally. The extent of automation and sophistication of data exchange is assessed in WAI Maturity Model capabilities 4.3, 4.4, 4.5, 4.6 and 4.7.

Standard Message Format: a predefined structure or template used for formatting and organizing data in messages to ensure consistency and compatibility between different systems or applications. This format specifies how data should be arranged, labeled and encoded so that it can be accurately interpreted and processed by all parties involved. Using common standards can facilitate effective data exchange between internal and with external systems.

Data Ingestion is the process of importing data from various sources into a central system or data repository for further use or analysis.

Data Integration is the process of combining data from different sources into a unified view or to enable analysis across multiple datasets. This can include mapping data from various formats or systems, merging datasets and ensuring consistency and accuracy across integrated data sources.

Data Management encompasses a range of activities to ensure data is accessible, secured, retained and effectively used. Procedures may include security and confidentiality protocols and data use agreements.

Data Quality Management is part of data management and includes processes for maintaining data accuracy, consistency and reliability, including data validation, cleaning and error correction.

Data Access refers to the ability to retrieve, view and interact with data stored in a system or database. It includes methods for querying and using data, which can include reading, modifying or deleting information. Access is typically controlled through security measures and access controls to ensure only authorized users or systems can obtain or manage the data.

Analyses (i.e., Data Analysis): systematically examining health-related data to identify trends, assess health outcomes and extract insights to support decision making. It includes applying statistical techniques, machine learning methods and other analytic tools to analyze data and interpret findings.

Appendix B. Governance Guide

Below is a guide to the types of policies, procedures and practices that may fall across systems, software and data governance.[50] The guide below is not exhaustive; however, it can support PHAs in considering opportunities for developing more robust governance processes.

Definition	Example Policy and Process Areas
Systems Governance	
The policies, processes and oversight mechanisms that manage and control an organization's IT systems and infrastructure. This includes hardware, software, networks and other technology resources. It ensures technology aligns with PHA objectives, remains secure, operates efficiently and complies with regulations and standards. Policies may be related to system development, implementation, maintenance and operation.	• Systems architecture management • Technology standards • Technology stacks (clarity on technologies available/how to use them) • System integration • IT project management • Artificial intelligence (AI) and generative AI • System acquisition, fulfillment and maintenance • System operations, monitoring and upgrades • Cyber security • IT security safeguards • System user access control • System interoperability management • IT project management **Cross-cutting:** • Agreements processes (e.g., data use agreements, contracts with systems vendors, etc.) • Legal considerations (federal and state laws, regulations) • User testing and acceptance sign-off practices and policies • Participation by groups of interest (e.g., patients, jurisdiction members, individuals who have experienced a health outcome) in prioritization, development and interpretation of data projects • Staff training
Software Governance	
A component of overall systems governance. It entails the policies, processes and oversight mechanisms that manage software applications and development processes, including off-the-shelf software and custom-developed applications. It involves setting policies and practices for software development, acquisition,	• Software acquisition and maintenance • Development processes • Compliance • Licensing management • Managing updates, upgrades and patches • Integration into infrastructure • User testing and acceptance sign-off • Security • Standards for code quality

[50] GSA IT Modernization Centers of Excellence. (2020). "Data & Analytics Center of Excellence Playbook." Accessed 09/17/24. Available at: https://coe.gsa.gov/docs/2020/Data%20Playbook-August2020.pdf

Definition	Example Policy and Process Areas
maintenance, integration and usage. It ensures that software supports PHA objectives while meeting regulations, quality and security standards.	• Project and overall lifecycle management • Documentation • Performance
Data Governance[51]	
A key component of overall systems governance is particularly relevant to public health. It entails the policies, processes and oversight mechanisms that manage PHA data assets (e.g., surveillance datasets, program evaluation data, administrative data). This includes data quality, data privacy, data security, data stewardship and data lifecycle management. It ensures that data is accurate, available and secure, and that it is used in ways that support PHA decision-making while being compliant with laws and regulations. Data governance is "…the people, policies, procedures and technologies that support how data are used and protected."[51]	• Data privacy and compliance management • Requisition and maintenance • Management and protection • Sharing • Data access guidelines and request procedures • Data ownership • De-identification and aggregation • Retention and archiving • Machine learning • Data catalogs, classification and metadata • Quality standards • Code books • Security • Storage and deletion

[51] The Public Health Informatics Institute (PHII). (2024). "Data Governance for Public Health." Accessed on 08/08/24. Available at: https://phii.org/data-governance This entire Data Governance section was adapted from PHII's online training curriculum.

Appendix C. Examples of Data Types

Examples of PHA data types include:[52]

- Healthcare capacity and availability*
- Primary care clinics
- Dental provider access, utilization and outcomes
- Chronic disease (surveys, electronic health records, ...)
- Reportable disease case investigation or management system, Electronic Case Reporting (eCR)*
- Sexually transmitted infections (STI, HIV/AIDS)*
- Electronic Laboratory Reporting (ELR)*
- Electronic Test Orders and Results (ETOR)*
- Laboratory Information Management System (LIMS)*
- Emergency Medical Services (EMS) and Emergency Department (ED)*
- Syndromic surveillance*
- Emergency preparedness, emergency supplies and resources
- Environmental health (vector control, food inspections, other inspections [pools, tattoo, ...], surface water quality, drinking water quality, indoor air, outdoor air, lead poisoning ...)
- Fee collection
- Use of PHA's services (education classes, health fairs, school outreach, vaccinations or other services, ...)
- Immunization*
- Maternal and Child Health (MCH)
- Wastewater surveillance*
- Vital statistics (including birth and death records)*
- Operations-based system data (e.g., from learning management systems, personnel/human resource systems, financial systems)

* Data types aligned with the core public health data sources identified in 2024 CDC PHDS milestones (healthcare capacity and utilization, case, laboratory, ED, immunization, wastewater data and vital statistics).

[52] Centers for Disease Control and Prevention (CDC). (2022). "Data Modernization Assessment Worksheet v.1.0." Accessed 07/12/24.

Appendix D. Crossover of PHDS Goals to WAI Maturity Model Capabilities

The following table offers a coarse alignment of the WAI Maturity Model capabilities within Dimension 4, Technical Capabilities, to the four PHDS goals:[53]

1. Strengthen the core of public health data.
2. Accelerate access to analytic and automated solutions to support public health investigations and advance opportunities for all people to attain their highest level of health.
3. Visualize and share insights to inform public health action.
4. Advance more open and interoperable public health data.

PHDS Goal(s)	WAI Maturity Model Capability (from Dimension 4. Technical Capabilities)
All	System Acquisition and Enhancements
2	Centralizing Common Organizational Functions
1, 4	Interoperability: Extent of External Electronic Data Exchange
1, 2, 4	Interoperability: External Exchange Message Format
1, 2, 4	Interoperability: External Exchange Mode
1, 2, 4	Interoperability: Internal Exchange Mode
1, 4	Interoperability: Degree of Systems Integration (External)
1, 2	Interoperability: Degree of Systems Integration (Internal)
2, 3	Data Management and Quality
2	Data Linkage and Deduplication
3	Effective Use of Data Findings

[53] Centers for Disease Control and Prevention (CDC). (2025) "About the Public Health Data Strategy." Accessed on 02/03/25.

Appendix E. Maturity and Adoption Scale References

References included within this section were used to understand existing maturity and adoption scale levels and definitions. Where indicated with an asterisk (*), the resource was also used to understand capabilities to include within the four dimensions driven by CDC's Data Modernization Initiative priorities.

Bloedorn EE, Kotras DM, Schwartz PJ, Chaney C, Chaney C, Patsis J. (2023). "The MITRE AI Maturity Model and Organizational Assessment Tool Guide: A Path to Successful AI Adoption." Accessed on 11/12/24. Available at: https://www.mitre.org/sites/default/files/2023-11/PR-22-1879-MITRE-AI-Maturity-Model-and-Organizational-Assessment-Tool-Guide.pdf.

Capability Maturity Model Integration (CMMI) Institute. (2020). "CMMI for Development, Version 2.0." Carnegie Mellon University. Accessed 09/17/24. Available at: https://cmmiinstitute.com/ with scale levels available at https://cmmiinstitute.com/learning/appraisals/levels.

Deloitte. (2018). "Digital Maturity Model." Accessed on 11/12/24. Available at: https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Technology-Media-Telecommunications/deloitte-digital-maturity-model.pdf.

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Swann R and Coleman T. (2020). "The Federal Government Data Maturity Model." Accessed 07/17/24. Available at:

https://neweditions.net/sites/default/files/sites/default/files/ACLDataCouncil/Federal%20Government%20Data%20Maturity%20Model.pdf.

The Data Management Association (DAMA) International. (2017). "DAMA-DMBOK: Data Management Body of Knowledge." Technics Publications. Accessed 11/12/24. Available at: https://www.dama.org/ and https://technicspub.com/dmbok/.

The Public Health Informatics Institute (PHII). "Building an Informatics-savvy Health Department: A Self-assessment Tool." Accessed 08/16/24. Available at: https://phii.org/download/informatics-health-department-self-assessment-tool/.

The following were not used to inform the WAI Maturity Model, but are related resources that readers may want to explore:

Association of State and Territorial Health Officials. (2024). "Successful Informatics Alignment" webpage. Accessed 08/24/24. Available at: https://www.astho.org/topic/resource/sia/?utm_source=PHW&utm_medium=newsletter&utm_campaign=Resource_Card&utm_content=Successful_Alignment&utm_term=Informatics.

NC Department of Health and Human Services. (2024). "Data Sharing Guidebook." Accessed 08/01/24. Available at: https://www.ncdhhs.gov/ncdhhs-data-sharing-guidebook/open.