

Key Points for Human Resource Development in Pathogen Genome Analysis at Japanese Public Health Institutes



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**Research to establish personnel systems and human resource
development methods for genome testing
at local public health laboratories**

Principal Investigator: Kenji Sadamasu

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The cover image was generated using generative AI (Image Creator), based on keywords including genome, cycle, and human resource development.

Introduction

Prefectural and municipal public health institutes (PHIs) are public research and testing organizations located in prefectures, designated cities, and core cities across Japan. In 2023, PHIs were officially recognized as regional hubs for science and technology.

Japan's population has been steadily declining since it peaked in 2004, and in 2024, the birth rate hit a record low of 1.15. Given these trends, it is unlikely that there will be a sufficient influx of young talent to fill positions at PHIs nationwide. At the same time, the need for effective responses to health crises is urgent, and local emergency situations can arise unexpectedly.

Ongoing human resource development is essential for PHIs to effectively serve as technical hubs in regional health crisis management. Notably, there have been significant advancements in areas such as pathogen genome analysis. Some challenges cannot be solved by a single PHI alone; therefore, collaboration between PHIs nationwide is necessary.

This guideline is based on the findings of the "Study Group for Establishing Personnel Systems and Human Resource Development Methods for Genomic Testing at Prefectural and Local Public Health Laboratories (24LA2003)." It highlights key considerations for creating a personnel development manual for microbiology at PHIs.

1. Human Resource Development Using Remote OJT

Many prefectural and municipal public health institutes (PHIs) have traditionally focused on on-the-job training (OJT), where employees learn skills and knowledge through their daily work, with external training (Off-JT) used as needed. This approach to continuous human resource development helps each employee grow, fosters a culture of mentoring within the organization, and is essential for enhancing the overall capabilities of PHIs.

However, in the specialized field of pathogen genome analysis using next-generation sequencing (NGS), traditional OJT may not be effective. The technology is highly specialized, and PHIs may lack the necessary instructors to provide adequate training.

Additionally, Off-JT may not always be practical due to various challenges such as geographic limitations, societal training needs, budgets, and alignment with course content. There are also numerous technical obstacles, such as the specialized equipment and digital infrastructure required for genome analysis. As a result, there is a need for a common analysis platform that can be used by all PHIs, along with clear policies and manuals for human resource development and evaluation.

From the learner's perspective, self-motivation and a system for collaborative learning with colleagues (mutual help) are essential. To address these needs, it is critical to promote remote OJT programs that can be implemented even in distant locations. PHIs that are capable of offering such support should cooperate by providing educational assistance and personnel dispatch.

【 Note 】 Japan Association of Public Health Institutes (JAPHI) is an organization consisting of 86 PHIs across six regions, serving as technical hubs for health crisis management. By working together and supporting each other, we can expect improvements in the quality of technologies across PHIs.

2. Visualizing Training and Testing Methods (Including Development)

In typical human resource development settings, a wide range of training materials is readily available and easy to access. However, training resources related to genome analysis technology and knowledge are currently limited. Additionally, the government often does not provide official methods or analytical platforms in a timely manner, leaving the infrastructure for training underdeveloped.

Given these challenges, those responsible for genome analysis training (trainers) must independently select or create the most suitable methods and materials to use in their training programs. It is also crucial to standardize the training methods and materials developed and implemented across the country. Relevant organizations must collaborate to address this issue.

【Note】 Traditionally, local public health institutes have incorporated manuals from the JIHS National Institute of Infectious Diseases (NIID) into their standard operating procedures and used them in testing. However, during emergencies, these manuals may not be available, or timely human resource development training may not be feasible. This issue is particularly common in workplaces with frequent personnel turnover.

2. Facilitating Individualized Learning through E-learning

Having standardized methods and training materials in place makes it easier for individuals to acquire knowledge. Regular lectures covering topics from basic to advanced levels, along with archiving the content, can be an effective way to support self-learning.

Since PHI staff members come from different professional backgrounds and progress at different rates, it can be difficult to ensure uniform knowledge acquisition in a short period of time. However, by leveraging tools like online training and archived lecture content, we can create an e-learning environment where anyone can learn as many times as they wish, regardless of time or location.

For this reason, it is important to systematically archive regularly scheduled lectures and other events, while continually improving and updating the content to keep it relevant.

【Note】 Traditionally, learning has involved reading papers and practicing through trial and error. However, with the ease of uploading and watching videos, there is no reason not to take advantage of these materials to enhance the learning process.

3. NGS-Related Skills to Be Acquired

PHIs require personnel who can reliably and creatively carry out work related to infectious diseases, foodborne illnesses, and their causative pathogens. This includes testing, investigations, and research, as well as the collection, analysis, and dissemination of relevant information.

As part of these activities, pathogen genome analysis using next-generation sequencing (NGS) may be conducted to obtain evidence for active epidemiological investigations and other response efforts. The skills required for such analysis are wide-ranging, and the appropriate proficiency level should be determined by each PHI according to its role and organizational structure.

Examples of skills required for genome analysis include:

- The ability to appropriately select pathogen genome testing methods suited to the objectives of health crisis management.
- The ability to perform pathogen genome analysis in cases related to health crisis management.
- The ability to further develop the knowledge and skills described above and apply them creatively in practice.
- For additional competencies, please refer to “Key Points for Creating a Human Resource Development Manual for Microbiology at PHIs.”

5. Proficiency in Related Skills

Proficiency refers to the long-term learning process through which individuals acquire practical knowledge and skills through experience, progressing from novice to expert. As shown in the Table, proficiency can be categorized into the following stages:

- Procedural Proficiency (1–2 years of work experience)
- Routine Proficiency (3–5 years of work experience)
- Adaptive Proficiency (approximately 6–10 years of work experience)
- Creative Proficiency (approximately 11 years or more of work experience)

Ideally, local public health institutes aim to develop and retain as many staff members at higher levels of proficiency as possible. To achieve this, it is essential to objectively assess each staff member's progress and depth of proficiency and to promote skill development systematically at the organizational level.

【Note】 Ultimately, the goal is for all PHIs to have a strong pool of proficiency experts.

Table Proficiency Stages

1 Procedural Proficiency (1–2 years of work experience)
Individuals with no work-related experience are classified as “novices,” and their expertise has scarcely
2 Routine Proficiency (3–5 years of work experience)
In the case of routine tasks, individuals become capable of performing them quickly and accurately.
3 Adaptive Proficiency (approximately 6–10 years of work experience)
This stage refers to the ability to proceed with tasks by reasoning through analogy depending on the situation. Commonly described as the “intermediate” level, individuals at this stage can manage non-routine
4 Creative Proficiency (approximately 11 years or more of work experience)
This stage is characterized by the ability to deliver a high level of performance both efficiently and accurately. Individuals who attain this stage are described as “experts,” and they are capable of developing

Adapted from Human Resource Development Handbook, supervised by D. Masaki, Diamond Publishing, 2019.

6. Human Resource Development Centered on Block Bases

PHIs across Japan are organized into regional blocks composed of geographically neighboring laboratories. When considered at the block level, situations in which no personnel have expertise in NGS analysis are expected to be far less common than when PHIs are considered individually.

In addition, PHIs within the same block interact frequently in their daily operations and already maintain collaborative relationships, creating a favorable environment for on-the-job training. In particular, the lending or shared use of high-performance analytical computers required for NGS analysis can play an important role in the early stages of training.

By establishing a training base for each block (a “block base”) and regularly conducting comprehensive training centered on these bases, collaboration within each block can be strengthened. This approach is expected to enhance overall technical capacity and improve human resource development standards across PHIs (see Figure).

Furthermore, connections formed among staff who participate in or conduct the same training programs will foster “mutual assistance” and collaborative learning. This, in turn, will support the continuous accumulation of knowledge and skills and help build long-term collaborative relationships.

【Note】 The JAPHI network is divided into six blocks. Block-based human resource development, rather than a fully national approach, is particularly effective in promoting collaborative learning and mutual support.

7. Factors for Selecting a Block Base for Genome Analysis

The following factors should be considered when selecting a block base for genome analysis. Among these, the presence of staff who are willing to take initiative and serve as leaders at the block base is particularly important.

- Analytical Computing Capacity

Sufficient computer processing power to perform NGS analysis smoothly and efficiently.

- Reliable Internet Connectivity

A communication environment that supports the rapid transfer of large datasets, as well as online training and remote technical support (remote OJT).

- Personnel and Commitment

A stable group of staff members who are highly motivated and dedicated to genome analysis and human resource development.

- Capacity to Conduct Regular Training Programs

An established system for planning and delivering systematic, continuous training seminars for staff both within and outside the block.

- Accessibility from Local Public Health Institutes

A location that is easily reachable from local public health research institutes within the block, enabling efficient travel and facilitating face-to-face training.

8. Learning Cycle

Employees who complete the training programs described above can apply the knowledge and skills they have acquired in their daily work at their home institutions, reinforcing and consolidating their learning through practice and reflection. In addition to sharing their expertise through OJT within the institute, they can also serve as instructors at training sessions hosted by other PHI research institutes. Teaching others further deepens their understanding and accelerates the mastery and retention of what they have learned.

【Note】 When trained staff members take on the role of instructors in subsequent training programs, the consolidation of their knowledge and skills is significantly accelerated. In addition, initiating new training programs provides opportunities to identify and nurture new talent.

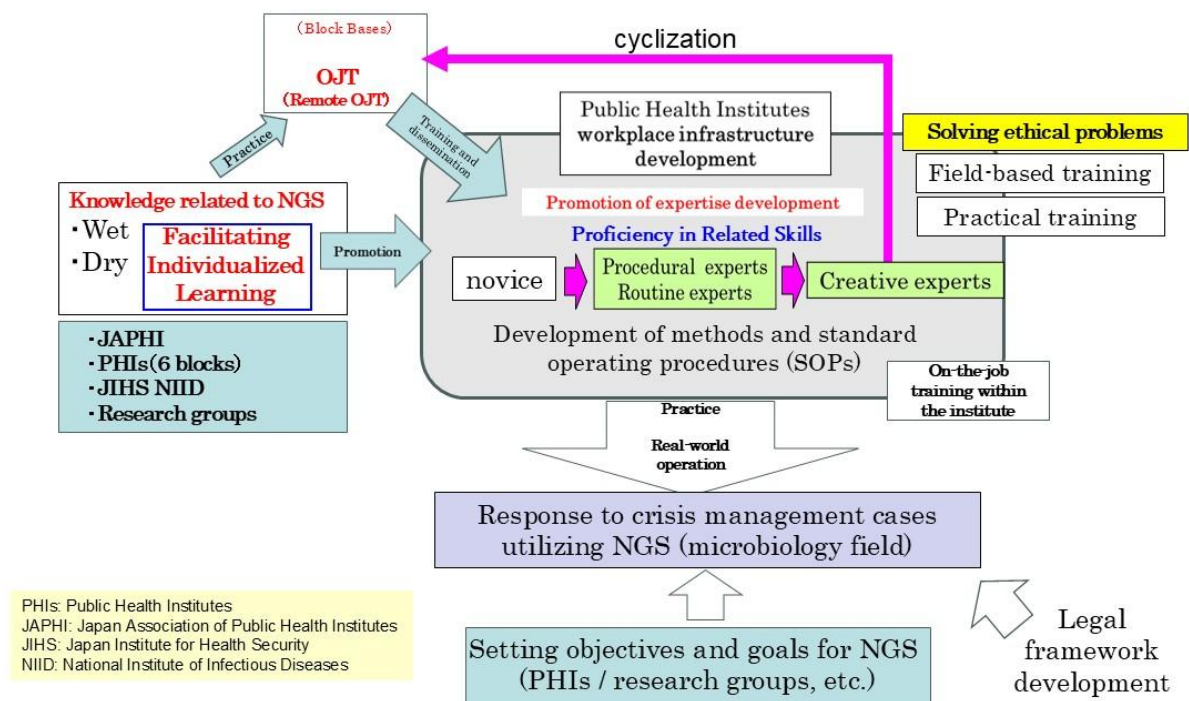


Figure Organizational framework for crisis management response using NGS in Public Health Institutes (microbiology field)

9. Practical Use of NGS

NGS analysis technology should not be limited to research applications; its use in routine administrative testing must also be considered. However, except in cases where national guidance is issued—such as during the COVID-19 pandemic—the decision to adopt NGS for administrative testing is left to individual local governments and public health institutes. As a result, the judgment and leadership of management personnel, including laboratory managers, play a critical role.

To support informed decision-making, it is important for PHIs nationwide to steadily accumulate examples of NGS applications in administrative testing and to share these experiences and outcomes across institutions.

【Note】 The ultimate goal of training is the practical application of NGS in infectious disease crisis management, which is a core responsibility of PHIs. Achieving this goal requires management personnel, such as laboratory managers, to actively decide to implement the knowledge and skills acquired through training in real-world practice.

Conclusion

PHI personnel who played key roles in the response to COVID-19 are valuable assets and serve as technical pillars of regional health crisis management. In addition to maintaining and strengthening their emergency response capabilities, it is essential that they continue to acquire new knowledge and skills during non-emergency periods.

Effective human resource development requires making use of training opportunities offered by organizations such as the JIHS National Institute of Infectious Diseases and private companies, as well as establishing training systems based on mutual cooperation among PHIs at the regional and national levels. Within such systems, it is particularly important to develop and effectively utilize personnel who can reliably perform their duties at PHIs through a structured, cyclical, and planned approach to training.

This guideline brings together the collective knowledge of members currently involved in the PHIs' Microbiology Human Resource Development Team. We hope that it will serve as a useful reference for the development of human resources in pathogen genome analysis at PHIs.

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Principal Investigator

Kenji Sadamasu

Tokyo Metropolitan Institute of Public Health

Co-Investigators

Tomotada Iwamoto, Ryohei Nomoto

Kobe Institute of Health

Hiroyuki Tsukagoshi

Gunma Prefectural Institute of Public Health and Environmental Sciences

Mami Nagashima, Hiroaki Kubota

Tokyo Metropolitan Institute of Public Health

Collaborating Researchers

Junji Seto

Yamagata Prefectural Institute of Public Health

Takayuki Wada

Osaka Metropolitan University

Yuto Ehara

Saitama Institute of Public Health

Hiroyuki Asakura, Yuki Sadamasu

Tokyo Metropolitan Institute of Public Health

Yusuke Yodotani

Kawasaki City Institute for Health and Safety

Yoshihiro Yasui

Aichi Prefectural Institute of Public Health

Jun Kawase

Shimane Prefectural Institute of Public Health and Environmental Science

Tsubasa Narita

Miyazaki Prefectural Institute for Public Health and Environment

Akie Sakagami

Miyagi Prefectural Institute of Public Health and Environment

Kaburagi Yasuo

Saitama City Institute of Health and Science

Hiroaki Shigemura

Fukuoka Institute of Health and Environmental Sciences

Shintaro Hirai

Ehime Prefectural Institute of Public Health and Environmental Science