REVIEW OF GENOMICS THAILAND INTEGRATED ACTION PLAN (2020–2024)

Thailand aspires to become a “regional hub for genomics research, diagnostics and treatment, with long-term social & economic benefits for Thailand”. The Genomics Thailand Integrated Action Plan (2020-2024) is driven by Ministry of Public Health, Ministry of Science and Technology, and Ministry of Education with collaborating network consisted of 11 relevant agencies. There are 6 key strategies in the plan :

1. Research and development
2. Service
3. Data analysis and management
4. Ethical, Legal and Social Implications (ELSI)
5. Human resource production and development
6. New industry development

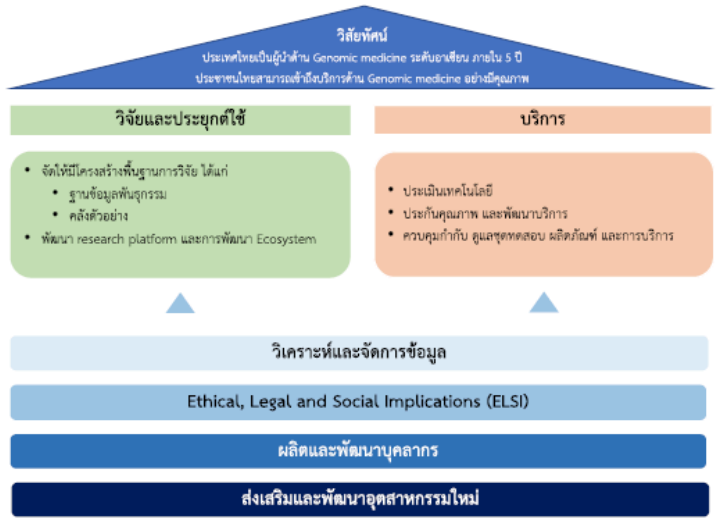

Figure 47 : Genomics Thailand 6 key strategies

The summary of the action plan by strategy is in Table 25 below.

Table 25 : Summary of Genomics Thailand Integrated Action Plan (2020-2024)’s strategies

Strategy	Overall objectives	Key initiatives
Strategy 1: Research and Implementation	To support and develop genomic medicine research, building a knowledge base and utilizing advanced technology to be able to compete on a regional and global level	1. Frontier research to develop Thai reference genome database 2. Human Biobank 3. Prospective, long-term cohort study 4. Analysis and identification of factor with strong genomic association to health and diseases 5. Implementation research 6. Academic conferences and development of annual research plan
Strategy 2 : Service	1. To improve genetic diagnosis to be up-todate with standard 2. To develop genomic service quality and standard guidelines 3. To propose inclusion of genomic services in national reimbursement schemes	1. Improve genetic diagnosis quality 2. Develop genomic service quality and standard guidelines 3. Propose inclusion of genomic services in national reimbursement schemes

Strategy	Overall objectives	Key initiatives
Strategy 3 : Data analysis and management	1. To serve research and knowledge creation 2. To serve genomic servicesin national reimbursement schemes	1. Collaborating with relevant stakeholders 2. Develop required human resources 3. Develop bioinformatic software and tools 4. Develop National Data Bank 5. Develop high-performance computing system
Strategy 4 : Ethical, Legal and Social Implications (ELSI)	1. To study key considerations in ELSI related to genomic medicine 2. To define relevant policies, law, regulations and practice guidelines 3. Promote understanding and involvement of society and relevant stakeholders	1. Form working team and committee responsible for ELSI 2. Support research in area of ELSI relevant to genomic medicine to inform future policy framework 3. Define relevant policies, law, regulations and practice guidelines with stakeholders' involvement 4. Promote general public understanding, awareness and involvement of the genomic initiatives 5. Support multi-agency research and development in human genomics
Strategy 5 : Human resource production and development	To develop required genomic medicine specialists : genetic residents/fellows, genetic counsellors, molecular specialists, and bioinformatic specialists	1. Short-term: practical certificate training for postgraduates 2. Long term: develop Ph.D. and medical specialists 3. Periodically adjust curriculum to be in line with industry needs
Strategy 6: New industry development	1. To support and promote new industry in the health service 2. To support implementation of research into health products/services 3. To support and promote genomic medicine start-ups in Thailand	1. Integrate needs and trends in genomic medicine in Thailand 2. Promote development of required infrastructure via public private partnership and foreign investment 3. Create and ecosystem that promote investment in genomic medicine 4. support implementation of research into health products/services

After the completion of the action plan in 2024, success of the plan has been clearly defined with KPIs set as shown in Table 26.

Table 26: Genomics Thailand Integrated Action Plan (2020-2024)'s goals and KPIs

Output	Quantitative KPIs	Qualitative KPIs
Genomic specialists	1. 34 genetic residents/fellows 2. 110 genetic counsellors 3. 150 multi-disciplinary genetic specialists 4. 500 bioinformatic specialists	1. Genetic residents/fellows need to pass American Board of Medical Genetics or local certificate, or equivalent 2. Genetic counsellors must possess master's degree or Ph.D. from local or international university approved by Office of Civil Service Commission or have American Board of Genetic Counseling certificates or equivalent 3. Multi-disciplinary genetic specialists must possess master's degree or Ph.D. 4. Bioinformatic specialists must possess master's degree or Ph.D.
Whole Genome Sequence Database	Whole genome sequencing data of at least 50,000 people	Thai researchers have access to genomic data and can use the data to advance their research and development
Software for genomic variation analytics	At least 5 bioinformatics software/tools	Software developed by Thai researchers and accessible to Thai researchers without additional costs
High Performance Computer with multi-core/processor technology	At least 1 system	Can handle large genomic data efficiently
Establishment of Thailand Medical Genetic association and Genomic ELSI national committee	1 Medical Genetic Association 1 national genomics ELSI committee	-
Genomic regulations and guideline regarding ELSI	At least 3 guidelines	-
Development of research center of ELSI considers in genetic and genomic medicine	At least 3 centers at Chulalongkorn Hospital, Ramathibodi Hospital, and Siriraj Hospital	-
Knowledge of genomic association with key diseases e.g. cancer, rare or undiagnosed disease and NCDs	At least 3 reports from research on genomic association to key diseases: cancer, rare or undiagnosed disease and NCDs	The research report is used to inform new policy and policy adjustment for national health services

Output	Quantitative KPIs	Qualitative KPIs
Information on pharmacogenomics, drug reaction, and appropriate use of drugs	At least 3 reports from research in pharmacogenomics, drug reaction and appropriate use of drugs	Pharmacogenomics data used to develop relevant national drug usage guidelines
Establish framework to evaluate new genomic diagnosis technology	At least 1 framework	New genomics technology used in Thailand are high quality and reliable
National reimbursement schemes cover genetic diagnosis	At least 1 item	New genomics technology used in Thailand are high quality and reliable
Establish framework for utilization of genomic data for medical use	At least 1 framework	Can be implemented in health services and can inform future policy shaping

After comparing the status of Thailand's genomics ecosystem with that of the benchmark countries, preliminary gaps are identified across each lever and sub-lever. Some of these gaps have already been addressed in the action plan, while some have not. Key improvement areas have been identified based on benchmark studies as shown in the table below.

Key Levers	Current plan addressing gaps	Detail of plan	Key improvement areas
 Business model & financing		• No plan for longer term investment beyond 5 years • Unclear commercialization model for genomic data and research	• Consider longer-term plans and commitment • Create clear business model to clearly communicatewhere private sectors/ international players can engage within Thailand genomics ecosystem and how genomic data and research can be commercialized
 Human capital		• Clearly detail the number and type of specialists to be developed • Consider adjusting curriculum/ academic degree offering to reflect changes in demand from the industry	• Create a concrete mechanism for future national genomic workforce management and planning

Key Levers	Current plan addressing gaps	Detail of plan	Key improvement areas
Ownership and governance		• To promote research in ELSIthat will inform future regulation/policy development and changes • In the process of drafting and approving "Human Genomic data Management Guideline"	• Consider setting up central dedicated entity responsible for genomics
Physical data & infrastructure		• Plan focuses more on promotion of investment in genomic laboratory without clear plan on promotion of dedicated genomic R&D center or expanding capability of current R&D centers • Strategy 3 is dedicated to creating development of required IT and data infrastructure: bioinformatic software, national data bank, and high performance computing system • To develop human biobank with central bank and distributed to relevant university/R&D center with budget of USD11 million	• Promotion and support for development ofgenomic research centers
Research & technology		• Outlined comprehensive research topics that will be carried out during the plan period which cover several treatment areas • Aims to develop at least 5 bioinformatic software by 2024 • Planned to promote development of genomic laboratories with international standards via Public Private Partnership and via foreign investment	• Prioritized promotion and support of companies/start-ups in genomic health service and technology but still without clear plan/strategy
Public education & awareness		• Under ELSI strategy, one of the key tasks is to promote understanding and participation of public via genomic education in schools/universities, and via exhibition or other media • Plan to hold academic conferences to present research progress/results and to exchange knowledge and ideas among researcher and enthusiasts	• Dedicated entity responsible for building awareness in the general public

Table 27 : Ecosystem gaps addressed by the action plan and key improvement areas