Towards a sustainable future for health equity: a policy brief on strengthening the science-policy-society interface in a low- and middle-income country for Biotechnology Research and Health Systems

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Abstract

Research and Development (R&D) in Biotechnology plays a big role in achieving a sustainable future for health equity particularly in a low-and middle-income country such as the Philippines. Through the *"Horizon Scan on the Biotechnology Path of the Philippines (HSBP)",* emerging technologies in 5, 10, and 20 years including current issues that can pose possible risks and threats particularly in the areas of science, policy, and society in achieving the future imagined were identified. The biggest threat identified in the project's health systems operational area is the challenging implementation and translation of health research in the country. This includes inefficient procurement practices for health research, uncoordinated information/policy with related R&D health agencies, and researchers not equipped in transitioning from R&D to marketing. Harnessing synergies and local resources needs a whole-of-society approach by fostering enabling systems conducive for timely conduct of research, involving strengthening support for researchers in research translation and across the research cycle, and incorporating participative processes in the research cycle.

Futures thinking, which is a methodological approach, and foresighting, which is the practical application are a set of methods and tools that are conducted in order to identify current and possible emerging issues that can be addressed in order to develop and realize the desired future [1]. Horizon Scanning on the other hand is a systematic foresighting tool that is used to identify potential threats, risks, emerging issues and opportunities [2] which can be used in preparation for the future through policy improvement and development.

With the release of Sustainable Development Goals (SDG) last 2019 comes the World Health Organization (WHO) "Triple Billion Targets" goals composed of *1 billion more people benefitting from universal health coverage, 1 billion more people better protected from health emergencies, and 1 billion more people enjoying better health and well being* by 2023 [3]. Both SDGs and Triple Billion Targets see Health Equity as one of the major goals in the future. In order to achieve this goal, the role of science and technology [4] particularly in the field of biotechnology is well recognized. With the rapid advancements in biotechnology, utilization of horizon scanning specially in low- and middle-income countries (LMICs), such as the Philippines, is crucial to ensure preparedness and sustainability for emerging technologies that may greatly impact the overall health systems in the country.

To maximize the opportunities for and minimize threats from emerging biotechnologies, a foresight project entitled: *"Horizon Scan on the Biotechnology Path of the Philippines (HSBP)"* was spearheaded by the National Committee on Biosafety of the Philippines. It aimed to elucidate eight out of the twelve national operational areas to guide sustainable policy direction, research path, and scientific advancement of the nation [5]. In this policy brief, the focus is given to health systems as it remains to be one of the most often neglected systems in countries in the Global South [6]. The stakeholders were divided into two (2) cohorts; the Health R&D Management and Translation cohort, and the Filipino Biotechnology Experts cohort since it is recognized that the conduct of R&D and success of a technology is not only solely dependent on the researchers, but the supporting systems as well. The participants were from different private and public higher educational institutions in the country, and are in the fields of: biotechnology, emerging technology, drug development, and biomedical devices.

The project's methodology is a modified version of the "investigate, discuss, estimate, aggregate, (IDEA)" protocol, that was also used in the WHO's "Emerging

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Trends and Technologies: a Horizon Scan for Global Public Health" in 2022 [4]. This activity was composed of 3 stages; (1) elicitation, (2) discussion and ranking of identified topics, and (3) policy making and roadmapping. In stage 1, the participants through an online elicitation survey answered the question "*Based on novelty, plausibility, and impact, which of the following biotechnologies will be relevant in 5, 10, and 20 years."* Answers for stage 1 were anonymously discussed by each participant which was then ranked in stage 2, and further discussed in stage 3 where consensus was made. Thematic analysis was used in all the stages. Discussions and inputs from the activity revealed the gaps and weaknesses in the current science-policy-society interface of the emerging health biotechnology landscape.

Table 1. Top identified health biotechnologies in 5, 10, and 20 years through the Horizon Scan on the Biotechnology Path of the Philippines (HSBP) Project basing on NAST's Pagtanaw 2050[1].

	5 years	**10 years**	**20 years**
Health R&D Management and Translation	1. Genomic (Pharmacogenetics) 2. Rapid and molecular diagnostics (infectious) 3. Assistive and supportive devices (rehabilitative devices for morbidity) 4. Wearable and sensors for health monitoring) 5. Natural products and therapy using natural products	1. Assistive and supportive devices (rehabilitative devices) 2. Genomics towards personalized medicine 3. Molecular diagnostics (pharmacogenetics) 4. Rapid and molecular diagnostics for communicable diseases 5. Rapid and molecular diagnostics for non communicable diseases	1. AI applications on imaging 2. Rapid and molecular diagnostics for communicable diseases 3. Rapid and molecular diagnostics for non communicable diseases 4. Multi-omics approach (combination of metabolomics, proteomics etc) as a way of life 5. Wearable and sensors for health monitoring that utilizes IoT and AI and can be used for/to monitor diseases stages/status and overall management
Filipino Biotechnology Experts	1. Wearable sensors for health monitoring 2. Natural products - targeted drug discovery, repurposing of known drug candidates 3. Multi-way tie - Locally manufactured devices for telemedicine - Rapid and molecular diagnostics; rapid test kits - 3D Printing bioprinting techniques - Telepresence devices - Natural products		1. Wearable and sensors for health monitoring that utilizes IoT and AI and can be used for/to monitor disease stage/status and overall management 2. Multi-way tie - AI driven healthcare solutions - Telemedicine/remote telemonitoring devices - AI-assisted robotics for healthcare in general - Enzyme biologics

The identified emerging health biotechnologies are presented in Table 1. For these biotechnologies to be adopted into the community, a whole-of-society approach is needed to bridge the transition from scientific results to comprehensive integration into health care facilities and communities. Moreover, the support of enabling regulatory agencies and industries are crucial in this endeavor, as illustrated in Figure 1. An example is the RxBox, a telemedicine device with built-in features of medical sensors (ECG, Pulse oximeter, BP app, fetal heart monitor, and maternal tocometer), and telemedicine features that transmits information from geographically isolated and disadvantaged areas (GIDAs) via the internet to a clinical specialist in the Philippine General Hospital [7]. It was only after rigorous training and technology support after deployment and inclusion of the community, including support from peers and champions (physicians and local government leaders) when continuous utilization of the device was seen in the community [8].

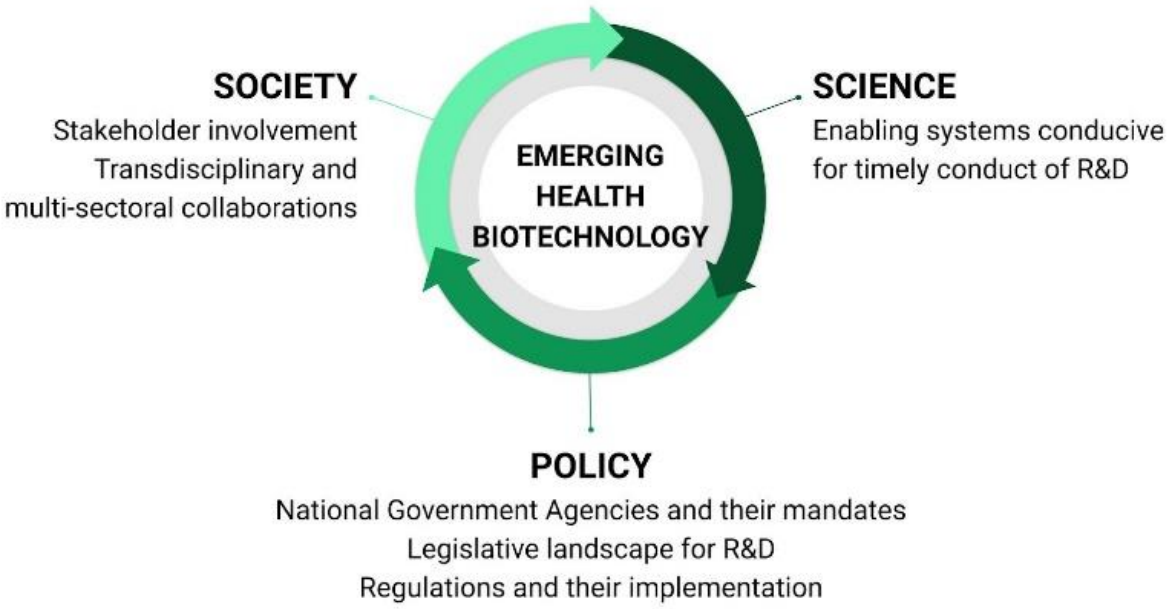

Figure 1. Proposed Science-Policy-Society Interface for the Sustainable Future for Health Equity through Utilization of Emerging Health Biotechnology.

Science, technology and innovation should be based on the needs of society to ensure better translation and adoption by end users. Once the technology has been developed, enabling policies must be in place for the conduct of research throughout its whole cycle, from development (procurement of raw materials) to adoption (technology transfer and commercialization) of the technology. In line with this, various gaps were also identified in this project, which are detailed in Table 2.

Table 2. Identified gaps and weaknesses that can impede the success of identified emerging technologies.

Science	Policy	Society

• Need to foster a more enabling research environment (funding grants, procurement)
  ○ Funding applications and conduct of research may sometimes be too taxing for the researchers due to numerous requirements needed even before the actual conduct of research is done
  ○ Few available local supply of raw materials needed for R&D
• Researchers are not equipped or lacks the knowledge when it comes to transitioning from R&D to marketing or in crafting proposals that has already considered the marketing in their output
	• Inefficient procurement practices for health research
	  ○ Available government regulations may not be conducive for timely conduct of research
	• Long waiting time due to bureaucratic processes sometimes lead to the expiry of reagents/obsoletion of equipment even before it can be utilized by the researcher
	• Lack of central office that deals with R&D procurement
	• Underdeveloped technology transfer and commercialization component: research results remain results and does not cross over to the market
		• Exclusion of community considerations in the technology development process
		• Low adoption of locally-developed outputs from the government and industry

It is estimated that as of 2016, the imports of medicinal and pharmaceutical products to the Philippines is at about 3,000 Million US dollars, coming from 500 Million US dollars in 2000 [9]. Majority of registered and regulated biomedical devices, medicines, and vaccines that are available in Philippine health facilities today are imported. In addition, the use of locally-developed biotechnology products that are tailored to Filipino people are yet to be maximized. This poor translation and utilization of local health R&D products contributes to the growing discouragement and frustration of health researchers while perpetuating high costs of health

products and service delivery. This ultimately plays a role in continued health inequity in the country.

Ways Forward

The interface of science-policy-society in translating health research requires building and strengthening at a systems level.

1. Fostering enabling systems conducive to the timely conduct of research

a. Tackling emerging fields requires up-to-date and functional infrastructure and facilities for research and development (R&D). DOST invests in funding for building and capacitating R&D facilities, such as the establishment of Niche Centers in the Regions for R&D (NICER) that focus on areas of industry, energy, and health.

b. There must be an increase in legislative support to increase ease of doing R&D, such as having a research-conducive procurement law and implementation. The Philippines need to adopt a model that allows for flexible procurement for research and development purposes. Currently, there are ongoing senate hearings to improve the procurement law.

c. Regulatory bodies must be geared towards evolution as emerging technologies drive innovation and new businesses to ensure responsive, if not proactive, creation, modification, and enforcement of regulations. The Food and Drug Administration Center for Device Regulation, Radiation Health and Research (FDA-CDRRHR) has been working with numerous national government agencies, including DOST, in enhancing its policies to aid in the translation of advanced technologies in health in the field of Biomedical Engineering and Diagnostics. These initiatives must continue and expand across the health research ecosystem. The partnership with FDA and other regulatory bodies must have provisions to accommodate the dynamic nature of R&D.

d. Increase use and/or support use of locally available raw materials to capitalize on the biodiversity and existing resources of the country. This is encouraged by the sectoral councils of DOST through prioritized funding for research utilizing abundant local materials.

e. Promote sharing of scientific data to accelerate biomedical research and innovation. The Collaborative R&D to Leverage the Economy (CRADLE) Program is an example of initiatives that support the growth of the Philippine Innovations ecosystem. This program fosters collaboration between higher education institutions (HEI) or research and development institutions (RDI) and industries, which include data and expertise sharing in biomedical research [11].

f. Engaging and enhancing capacities of young researchers to become the pool of local experts in emerging technologies is crucial in sustaining and growing the R&D ecosystem. The DOST, through its Science Education Institute, grants scholarships and study programs aimed at developing young researchers. Moreover, its sectoral councils and research and development institutes forge local and international collaborations with capacity building components that offer avenues for supporting scientists in emerging technologies.

g. Funding support across the research cycle must be adequate to allow scale-up and translation of discoveries, devices, and knowledge dissemination. Every year, the sectoral councils update their priority topics to enable funding for emerging fields. Only studies aligned to the priority topics will be eligible for funding.

2. Strengthening support for researchers in research translation and across the research cycle

a. Science communication and knowledge dissemination increases awareness and promotes education for the general public. This DOST Science and Technology Information Institute has various programs that tackle research communication and dissemination. This initiative is embedded in the research outputs of proposals as well.

b. Technology transfer, commercialization, marketing and business aspects have multiple effects, such as capacity building, health system enhancement, and economic development, aligning with DOST's strategic pillars on wealth creation and sustainability. The DOST Technology Application and Promotion Institute for example has various programs that provide financial grants and technical assistance to researchers who are moving their research into the market [12].

3. Incorporating participative processes in the research cycle

a. Building partnerships between academic institutions, research institutions, and industries

b. Involvement of relevant stakeholders, such as communities, industries, and government agencies, is crucial throughout the research cycle from problem identification to validation of findings and to increase ownership and uptake of biomedical research and technologies. Thus, PCHRD conducts stakeholder consultations in the construction of health research agendas.
c. Continued dialogues and learning sessions to share best practices and ensure open communication across different sectors, actors, and disciplines

Drawing from the identified challenges and limitations, the call to action requires a whole-of-society approach to ensure the synergy of strengths and resources in LMICs. Transformative change requires diverse players working together towards sustainable solutions with coordinated effort across sectors, stakeholders, and disciplines.

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