



**Asia-Pacific
Economic Cooperation**

Advancing Free Trade
for Asia-Pacific **Prosperity**

Artificial Intelligence (AI) Policy Recommendation on Digital Transformation for Healthcare Ecosystem - AI Policy Report

APEC Policy Partnership on Science, Technology and Innovation

December 2021



**Asia-Pacific
Economic Cooperation**

**Artificial Intelligence (AI) Policy
Recommendation on Digital Transformation for
Healthcare Ecosystem**

AI POLICY REPORT

**APEC Policy Partnership on Science, Technology and
Innovation**

December 2021

APEC Project: PPSTI 02 2020A

Produced by
Chen-Yang Hsu
Industrial Technology Research Institute, Chinese Taipei

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
[Tel: \(65\)68919 600](tel:(65)68919600)
Fax: (65)68919 690
Email: info@apec.org
Website: www.apec.org

©2021 APEC Secretariat

APEC#221-PP-1.6

Contents

Executive Summary	3
1. Introduction	5
2. Background	5
3. Artificial Intelligence Policy Recommendation on Digital Transformation for Healthcare Ecosystem	7
4. Conclusion	12
Appendix	13
References	34

Executive Summary

The rapid progression in computation science and the breakthrough in the algorithms of artificial intelligence and machine learning (AI/ML) largely contribute to the digital transformation for healthcare. Stemming from this digitalized platform of healthcare, the use of AI/ML algorithms in the clinical practices including diagnosis and treatment for variety diseases and the precision prevention of diseases are increasing. The COVID-19 pandemic further accelerates this process. It is thus of great importance for the scientists and policymakers of APEC economies to work jointly to develop a framework to facilitate the digital transformation in healthcare by using AI technology to reach the goal of population health in the context of SDG. To reach this aim, a project on Artificial Intelligence Policy Recommendation on Digital Transformation for Healthcare Ecosystem was hold by Chinese Taipei. Though the webinar held on August 11st and 12nd, the interdisciplinary discussion and collaboration between the APEC economies focusing on digital healthcare transformation was facilitated by this project. Two themes, **Policy Engagement** and **Practice Implementation**, were covered by this project, both are the fundamental issues to be address before a successful transformation to digital health care and precision health for APEC economies with an AI/ML underpinning. Experts from APEC economies and enterprise were invited to share their experience.

Regarding the theme of **Policy Engagement**, four major components emphasized in the project for a sustainable and successful development of digital healthcare with AI/ML are

- (1) regulation for innovative digital health technologies;
- (2) adaptation of healthcare provider;
- (3) empowerment of Patient and client; and
- (4) collaboration of stakeholders.

In addition to the policy recommendations, a real-word implementation of AI/ML by using pragmatic researches conducted in hospital and community was demonstrated for the theme of **Practice Implementation** to emphasize the usefulness of this innovative technology for healthcare in the spectrum of disease prevention.

Although the application of AI/ML algorithms to healthcare is faced with the issues such as interpretability, transparency, and patient safety, a sound

framework with policy engagement and practical considerations established by interdisciplinary collaboration guarantees a successful and sustainable digital healthcare transformation for APEC economies.

1. Introduction

The decline in birth rate in a society with aging population brings challenging issues on healthcare services in terms of both medical needs of disease prevention and treatment and the capacities to meet these needs. This imminent threat has affected most of the APEC economies. Although the approach of personalized medicine and precision healthcare can be the solution to these issues, its implementation involved with multi-dimensional measurements including demographic characteristics, anthropometric measures, life style factors, comorbidities, medication histories, biochemical markers, sequence markers, radiomics, metabolomics, proteomics, genomics, and epigenomics render the realization of precision healthcare a slow process. The lack of a supportive infrastructure in terms of patient empowerment, provider adaption, integrated platform of software and hardware, and policy aspects further hampers the digital healthcare transformation.

It is thus of great importance for the scientists and policymakers of APEC economies to work jointly to develop a framework to facilitate the digital transformation in healthcare by using AI technology to reach the goal of population health in the context of SDG [1].

On the basis of these issues, the project on Artificial Intelligence Policy Recommendation on Digital Transformation for Healthcare Ecosystem was held by Chinese Taipei in early August focusing the aspects of policy and implementation of this transformation in terms of administration, scientific research, and enterprise to accelerate this transformation in APEC economies.

2. Background

To reach a sustainable development of precision healthcare facilitated by the AI technologies for the APEC economies, Chinese Taipei conducted a project on Artificial Intelligence (AI) Policy Recommendation on Digital Transformation for Healthcare Ecosystem on August 11 to 12, 2021. To reach a successful and sustainable transformation toward the digital transformation for healthcare, the engagement of policy and the pragmatic implementation of innovative AI/ML technologies from hospital to community cannot be overemphasized. Both are the main themes of this project.

The experts from multiple fields including policy, economy, computer science, medicine, pharmacy, and clinical practices were invited to share their experiences and concerns on the digital transform of healthcare. Speaker from the APEC economies of Chinese Taipei, Japan, Chile, Philippines, Thailand,

and Malaysia attended this two-day webinar to have a panoramic view on the process and status of digital health transformation across the economies of APEC. In addition to the experts from the economies of APEC, the experts from the enterprise in including Graphen, Pfizer, and Google Health also join the webinar. Through this interdisciplinary crosstalk by the expert from different economies of APEC and the input from enterprise perspective, we aimed to look for the optimal process for the digital health transformation.

Prior to the launch of webinar, a questionnaire focusing on the current status on the planning and practice of digital healthcare and the incorporation of artificial intelligence (AI) and machine learning (ML) algorithms in the workflow of healthcare was provide to relevant personnel of APEC economies. Through this approach, the themes and issues on digital transformation of healthcare were explored and used as the input of this webinar. The questionnaire and the responses were summarized in Appendix A. The summaries of this project are detailed as follows.

3. Artificial Intelligence Policy Recommendation on Digital Transformation for Healthcare Ecosystem

Following the rationale mentioned above, this project on Artificial Intelligence Policy Recommendation on Digital Transformation for Healthcare Ecosystem invited distinguished experts from APEC economies specialized in the field of economy, policy, health science, health informatics, digital science, and AI not only to share their experience on the development policy and the implementation of AI technologies throughout the process of digital transformation in healthcare but also to raise and address the issues and obstacles that have been encountered in this process. Through such an interdisciplinary cooperation from the experts of these fields, the roadmap toward a successful and sustainable digital health transformation can be established.

3.1 Policy Engagement to Accelerate Digital Transformation for Healthcare

For the theme of **Policy Engagement to Accelerate Digital Transformation for Healthcare** (the first-day webinar), four key domains for a successful and sustainable transformation for healthcare were summarized, namely (1) regulation for innovative digital health technologies; (2) adaptation of healthcare provider; (3) empowerment of Patient and client; and (4) collaboration of stakeholders. The summary regarding these four major domains can be addressed as follows.

3.1.1 Regulation for innovative digital health technologies

(1) A clear regulation on the development, implementation, and business model

is indispensable for a successful digital transformation in healthcare.

(2) Policy support plays a major role for the balance between innovation and

patient safety with a sound framework of regulation.

(3) ***Themes enlightened in the webinar session***

Dr. Nor Azhariah binti Noordin, Malaysia

“Policy Driven Digital Transformation of Healthcare Service: Malaysia Experience”

Obstacles that may be encountered in digital health transform including the follows were addressed.

- (i) Financial constraint
- (ii) Interdisciplinary collaboration and expertise
- (iii) Reform of regulation
- (iv) Lack of guideline and poor acceptance among the healthcare service providers and users”

Dr. Chai Wutiwivatchai, Thailand

“From Tradition to Innovation-Policy-Driven Transformation in Healthcare”

Innovation deployment in crisis does not guarantee its acceptability in the normal situation and the real market.

Promoting sustainable innovation to support the digital transformation in healthcare through Integrating AI technology and services to enhance the added-value of products and solutions, following up on AI policy making.

Dr. Demian Arancibia and Dr. Carlos Avila, Chile

“Open data system with emphasis on creation of collective knowledge about pandemic”

Policy support is required to build the platform (Data observatory) which is the key component for the realization of digital health.

3.1.2. Adaptation of healthcare provider

- (1) The incorporation of innovative health technologies into the practice of healthcare providers is a key step toward a success digital transformation in healthcare.
- (2) A clear presentation and elaboration on the validity and usefulness of innovative technology stemming from digital health transformation can improve the acceptance among healthcare providers.
- (3) ***Themes enlightened in the webinar session***

Dr. Chien- Cheng Tai, Chinese Taipei

“Technology Innovation and Transformation in Healthcare”

AI technology can improve both of patient and healthcare providers’ outcomes numerically.

Dr. Demian Arancibia and Dr. Carlos Avila, Chile

“Open data system with emphasis on creation of collective knowledge about pandemic”

Integrated platform for collecting data with different sources derived by the sectors of public, private, and academic for reaching the following purposes.

- (i) Informed decision making;
- (ii) Scientific and clinical research
- (iii) Innovative solution
- (iv) Benefit for society.

These aims have been demonstrated in the Chile in applying such a platform for monitoring and containing COVID-19 outbreaks.

3.1.3 Empowerment of Patient and client

(1) The development of innovative digital healthcare with regard to the cultural

context of each economy can be a cornerstone for the implementation digital health transformation.

(2) Incorporating the perspective of patient and client can strengthen the uptake

of innovative services provided by digital healthcare.

(3) Empowerment of patient and client can accelerate the accommodation of

digital healthcare as a new norm.

(4) *Themes enlightened in the webinar session*

Dr. Chien- Cheng Tai, Chinese Taipei

“Technology Innovation and Transformation in Healthcare”

AI Empowers Primary Care Providers and Patients: AI tools help to improve the accuracy of medical diagnosis, deliver better patient engagement and help make healthcare providers more efficient and provide higher quality of care.

Dr. Chai Wutiwivatchai, Thailand

“From Tradition to Innovation-Policy-Driven Transformation in Healthcare”

Digital transformation in healthcare involves not only the provider side such as hospital practice but also the client aspect for personal health record and self-care for disease control, both driving to the change in the norm of health care.

3.1.4 Collaboration of stakeholders

(1) The stakeholders of healthcare enterprise can be represented by the groups

from regulator, provider, patient and consumer, and health care payer.

(2) The collaboration of multiple stakeholders is indispensable for an

enterprise

model of digital health transformation and precision healthcare.

(3) Themes enlightened in the webinar session

Dr. Nor Azhariah binti Noordin, Malaysia

“Policy Driven Digital Transformation of Healthcare Service: Malaysia Experience”

The components listed below are indispensable for a success and sustained digital transformation in healthcare.

- (i) Enterprise design
- (ii) Collaboration of multiple stakeholders
- (iii) Leadership and governance

Dr. Demian Arancibia and Dr. Carlos Avila, Chile

“Open data system with emphasis on creation of collective knowledge about pandemic”

Data Observatory (DO) for COVID-19 Pandemic is established by a public-private foundation incorporating Ministry of Science, Ministry of Economy, AWS and Universidad Adolfo Ibáñez. The DO project aims to maximize the exploitation by the global scientific community, industry and the public sector, facilitating access, analysis, exploration, visualization and governance.

3.2 Best Practice Sharing on How to Provide High Quality of Healthcare using AI Technologies

In addition to the policy recommendations, we further demonstrated the real-world implementation of AI/ML by using pragmatic researches conducted in hospital and community to emphasize the usefulness of this innovative technology for healthcare in the spectrum of disease prevention.

Stemming from the big analytics by using the technologies of AI/ML, a series of the innovative approaches have been developed to reshape the landscape of healthcare toward precision health. This theme is thus the focus of the second-day webinar. Through the sharing from the elites of a variety of fields, the experiences on the application of AI technologies in pharmaceutical development, precision oncology, AI in ophthalmology including glaucoma and diabetic retinopathy, and the field application of such a novel module to strengthen the quality of healthcare in community. The summary derived from the shared practice are listed as follows.

3.2.1 Digital technology for precision healthcare

- (1) The advancement in bioscience have initiated the evolution from personalized medicine focusing on tertiary prevention to precision health for the population with primary and secondary prevention.
- (2) The industry of data science and digital technologies with AI/ML underpinning further accelerates this paradigm shift in healthcare.

3.2.2 Precision healthcare from hospital to community

- (1) The AI/ML technologies are increasingly developed in healthcare for the spectrum of disease prevention in the settings of hospital and community.
- (2) The AI technologies can improve the accountability of healthcare providers
and the accessibility of patients and clients.

Through the crosstalk between the expert from different field and economy, the usefulness and the perspective of AI technologies in digital transformation for healthcare in the context of each economy of APEC can be inspired.

4. Conclusion

The provision of health services in an aging society has long been a challenging task for the APEC economies [1]. Although the COVID-19 pandemic has aggravated the overburdened health care systems of APEC economies, the accelerated development in health technologies during this period also revealed the chance for the implementation of digital healthcare [2-6]. In this webinar, the issues on the establishment of the framework for a successful and sustainable digital health transformation were discussed. Although the application of AI/ML algorithms to healthcare is faced with the issues such as interpretability, transparency, and patient safety [7-9], a sound framework with policy engagement and practical considerations established by interdisciplinary collaboration guarantees a success digital transformation for healthcare for economies of APEC [10-12].

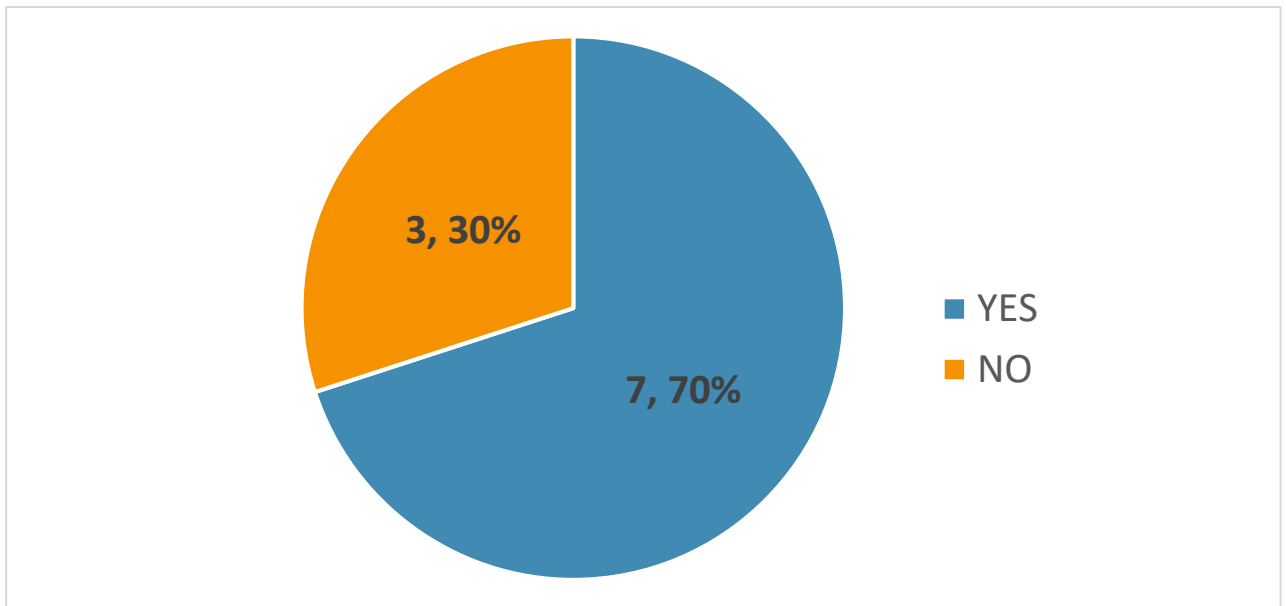
Both the speech of Dr. Wu from Chinese Taipei with the topic of “Policy on the Application of Digital Technology to Chronic Disease Control” and that of Dr. Esaki from Japan with the topic of “The Precision Healthcare – The Use of Artificial Intelligence in the Medical Field” vividly depict the scope on applying AI stemming from digital transformation for precision healthcare. Owing to the COVID-19 pandemic in 2020, the pace of digital health transformation has been accelerated in APEC economies. However, an integrated framework is required to guide the application of digital technologies to meet the needs in healthcare and to benefit the society. With the development of innovative technology, the four domains of digital health transformation mentioned in the webinar are expected to be implemented to reach the goal of precision healthcare.

Appendix

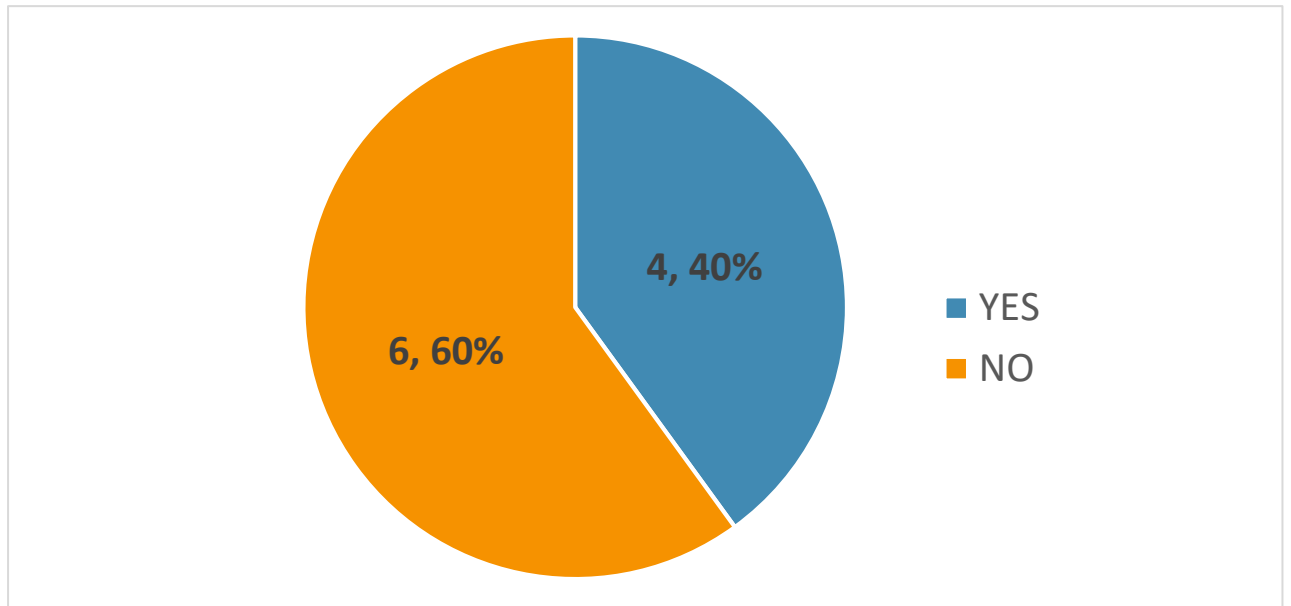
Appendix A. Summary of the Responses of Premeeting Questionnaire

The current status of AI applications in Healthcare in APEC economies

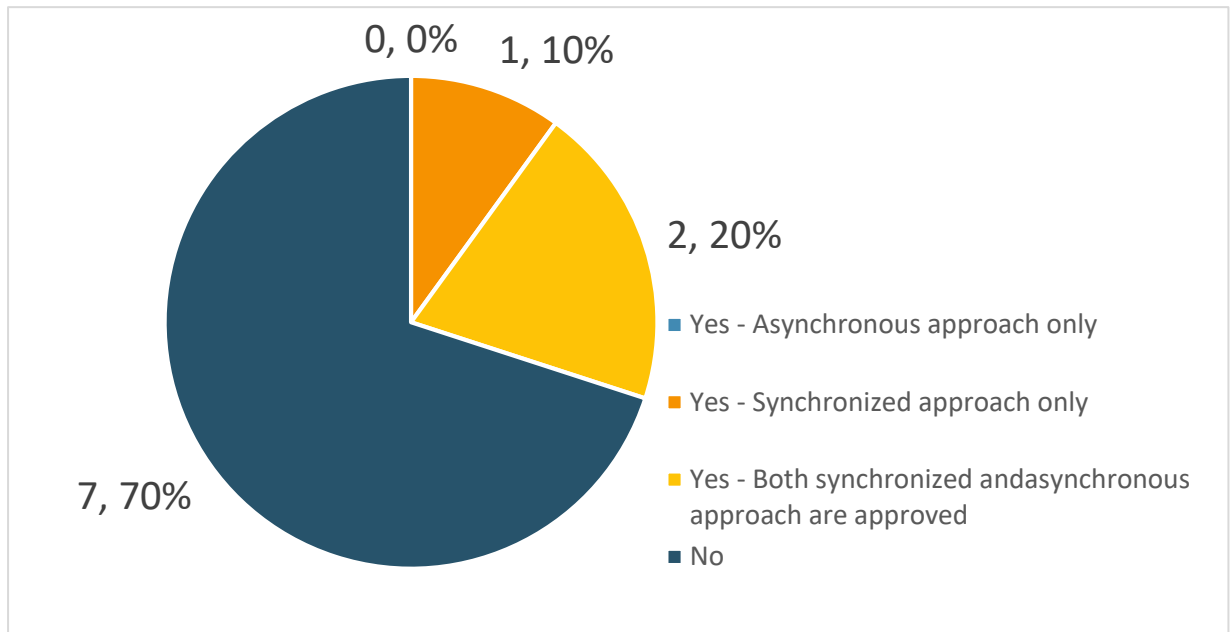
1. Is the use of AI technology to assist the decision for medical personnel on the diagnosis, treatment, and therapy approved by the regulation in your economy/area?



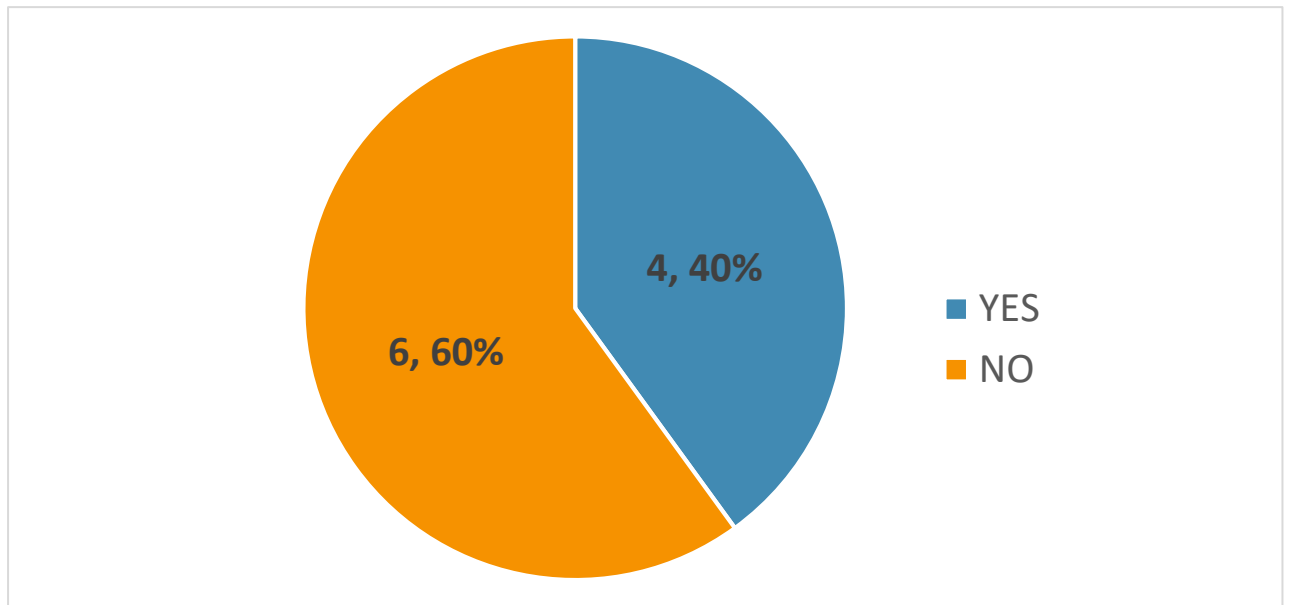
2. Is the use of AI technology to assist the decision for medical personnel on health checkup/disease screening approved by the regulation in your economy/area?



3. Are medical personnel approved by the regulation to make the diagnosis with the assistance from AI by using telemedicine with a synchronized or asynchronous approach in your economy/area?

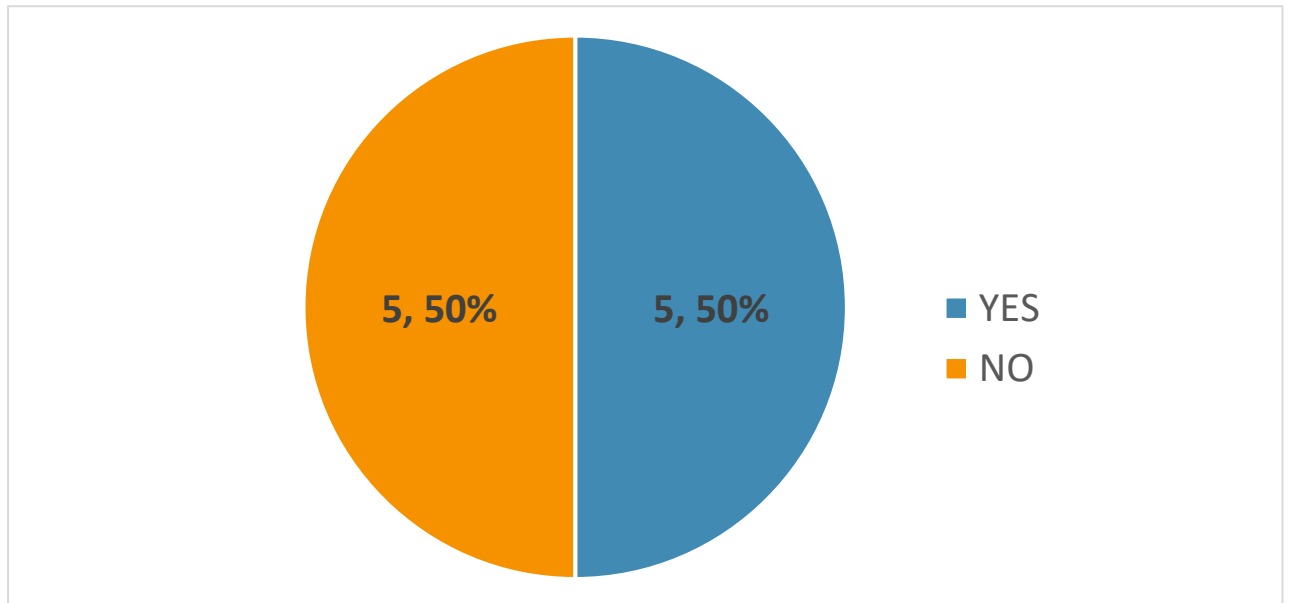


4. Are medical personnel approved by the regulation to perform health checkup/disease screening with the assistance from AI?



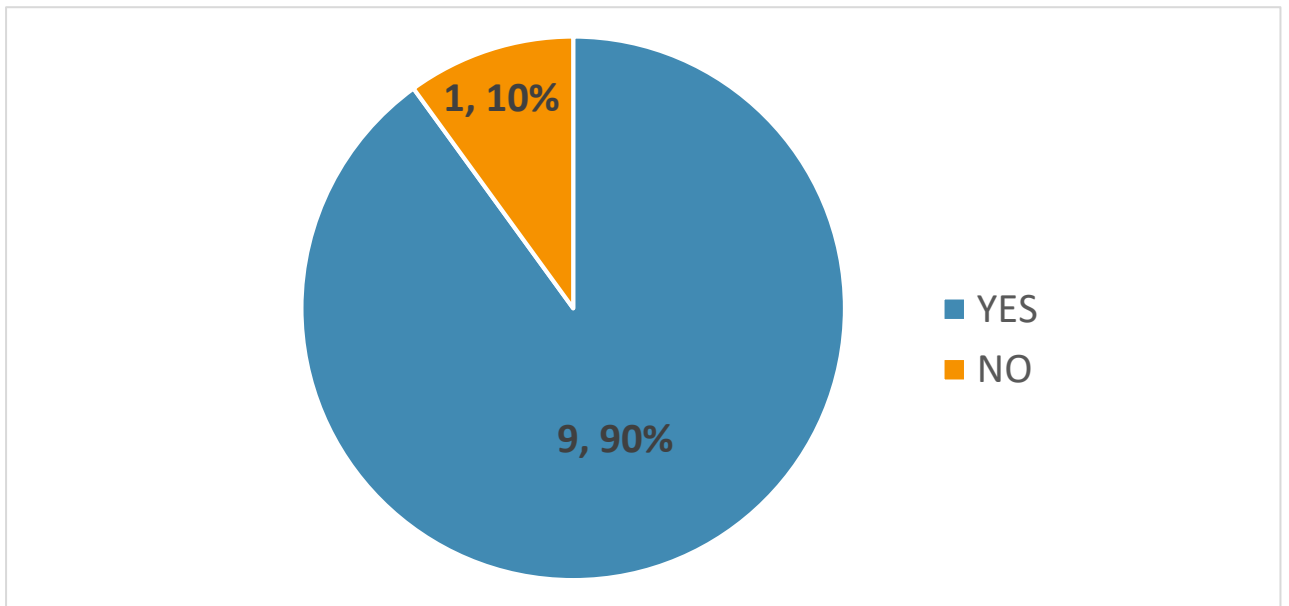
5. Have the regulatory sandboxes been incorporated as part of the supervision and management for healthcare services in your economy/area?

Note: Regulatory sandboxes. A regulatory sandbox is a framework set up by a regulator that allows innovators to conduct live experiments in a controlled environment under a regulator's supervision.

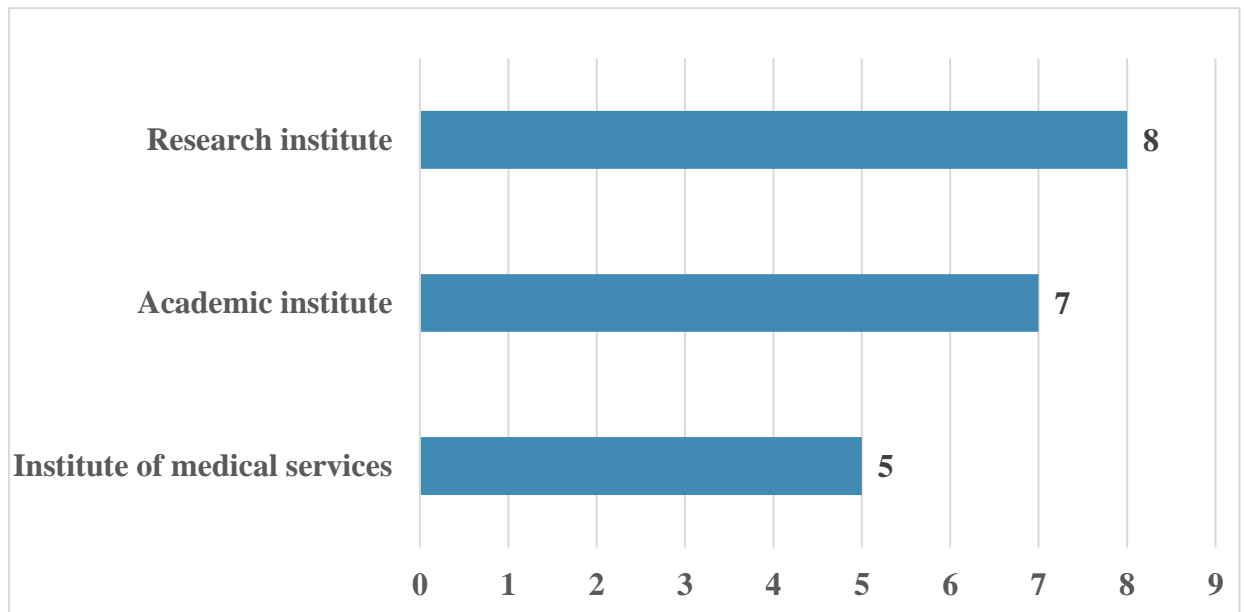


6. Are there any institutions that have engaged in the research and development of AI-based healthcare services in your economy/area?

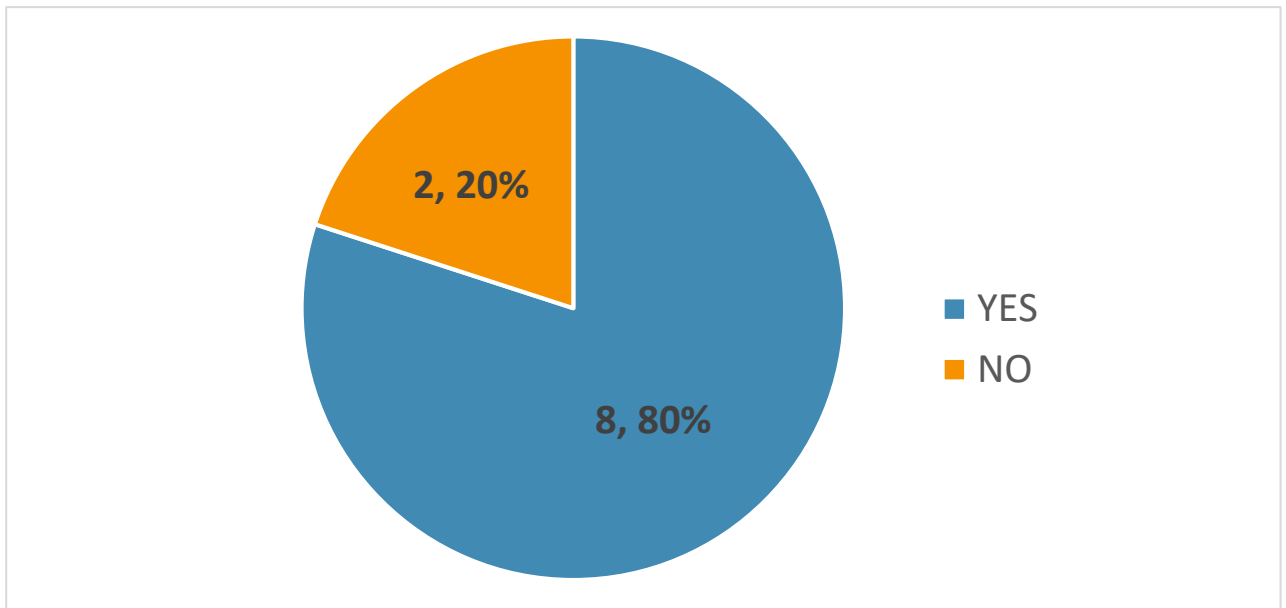
Note: Artificial intelligence in healthcare is an overarching term used to describe the use of machine-learning algorithms and software, or artificial intelligence (AI), to mimic human cognition in the analysis, presentation, and comprehension of complex medical and healthcare data.



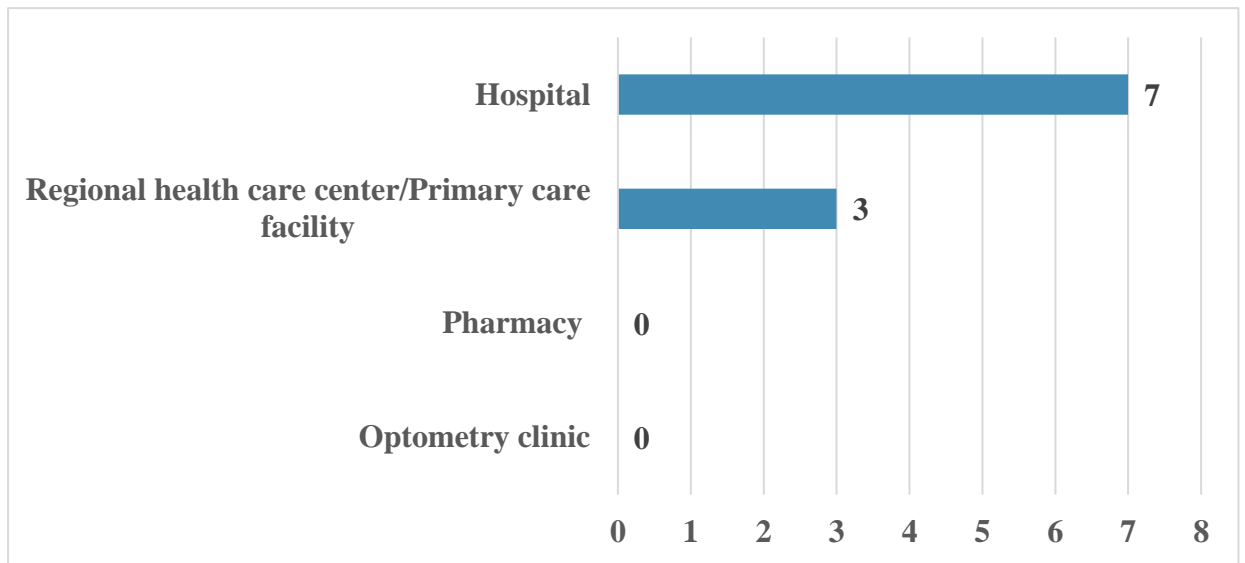
7. What type of institutions have engaged in the project for the research and development of AI-based healthcare services in your economy/area? (multiple choice)



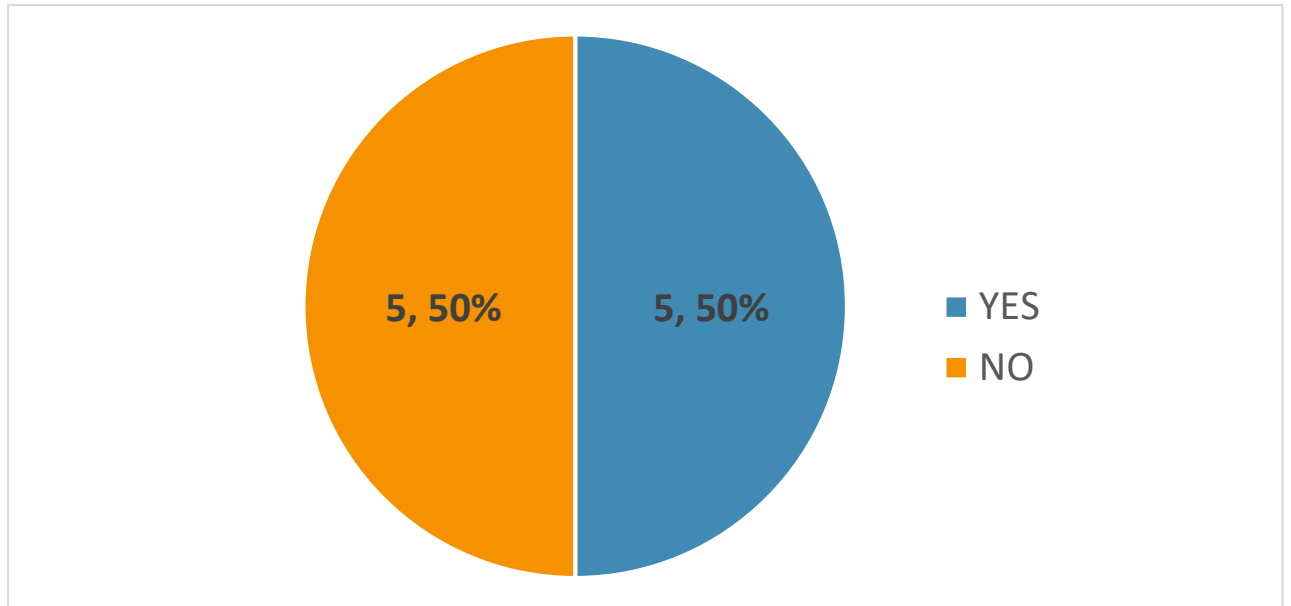
8. Are there any projects regarding the implementation of AI-based healthcare services in your economy/region?



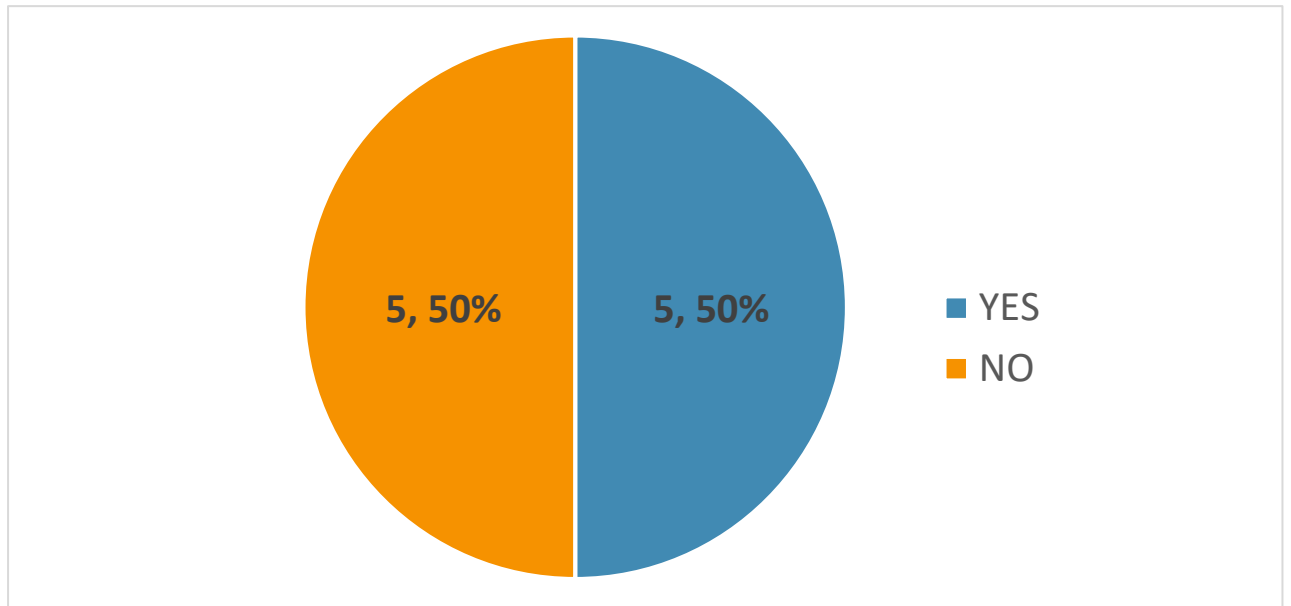
9. What type of institutions have implemented the AI-based healthcare services as part of field research? (multiple choice)



10. Are there any business models regarding the provision of AI-based healthcare services in your economy/area?



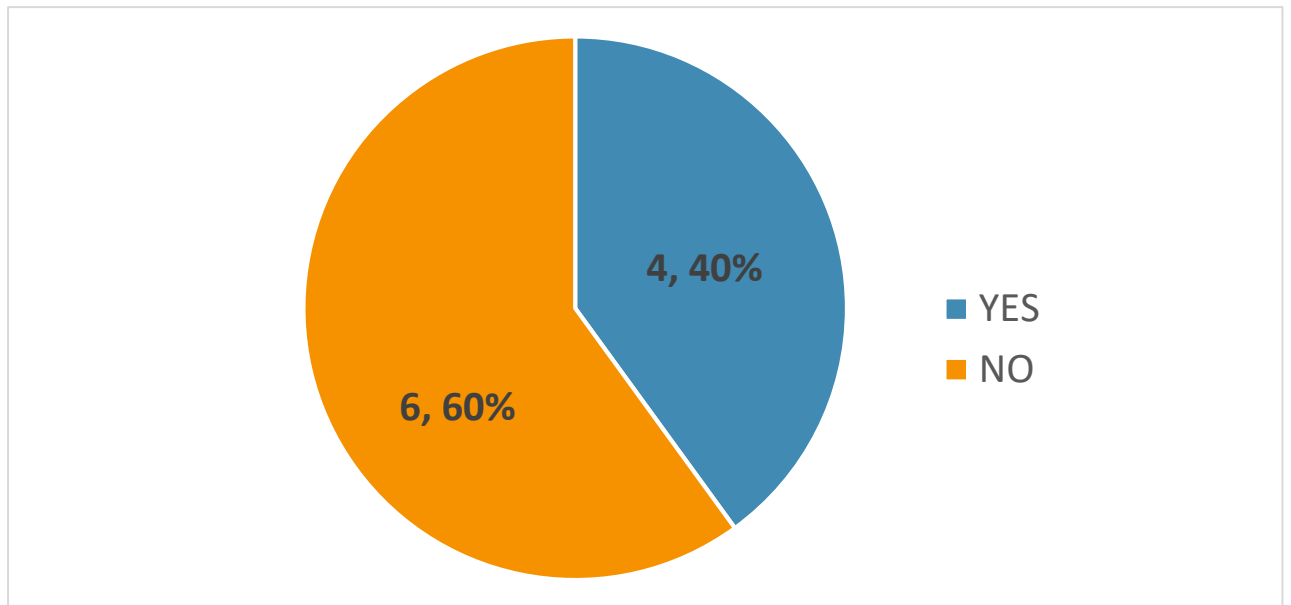
11.Does official authority/government play the main role in the development and application of AI-based healthcare services in your economy/area?



12. Following question 11, which department(s) of the official authority/government in your economy/area is(are) in charge of the development of AI-based healthcare services?

Economy area	Department(s) of the official authority/government
Indonesia	Ministry of Communication and Information of the Republic of Indonesia
Papua New Guinea	Department of Health and PNG Science & Technology Council
Malaysia	NIH Malaysia and Ministry of Science, Technology and Innovation (MOSTI)
Malaysia	Ministry Of Science, Technology and Innovation
A regional economic forum to leverage the growing interdependence of the Asia-Pacific	Ministry of Health
Thailand	Department of Science and Technology and Department of Trade and Industry

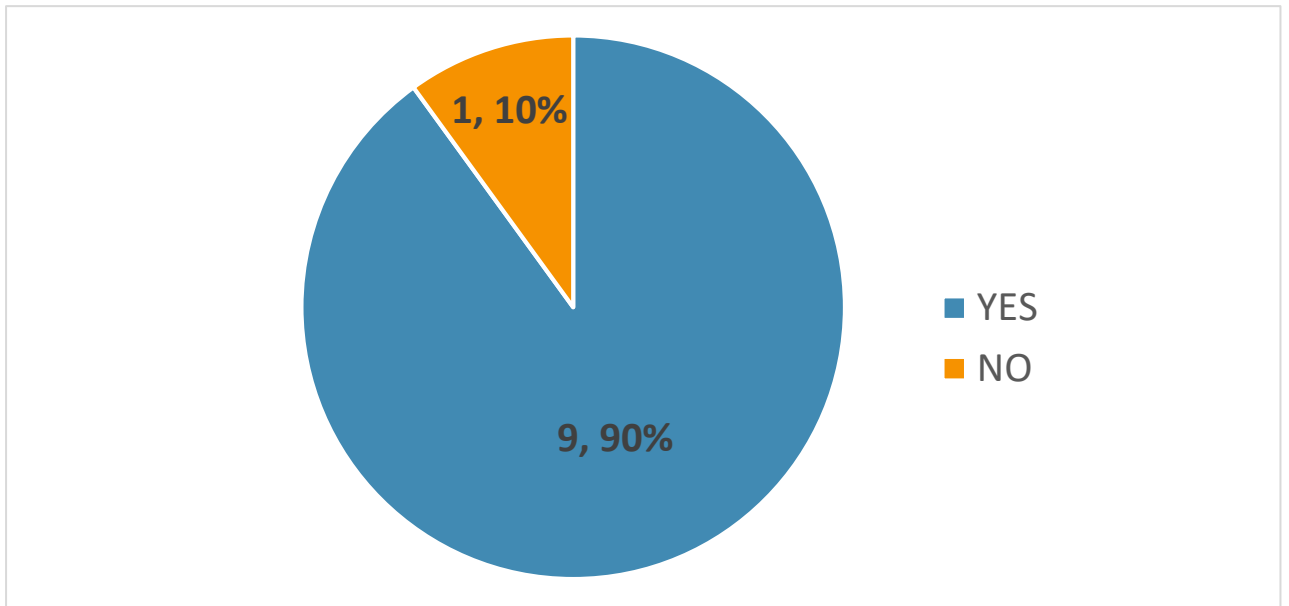
13. Are there non-government organizations facilitating the implementation of AI-based healthcare service in your economy/area?



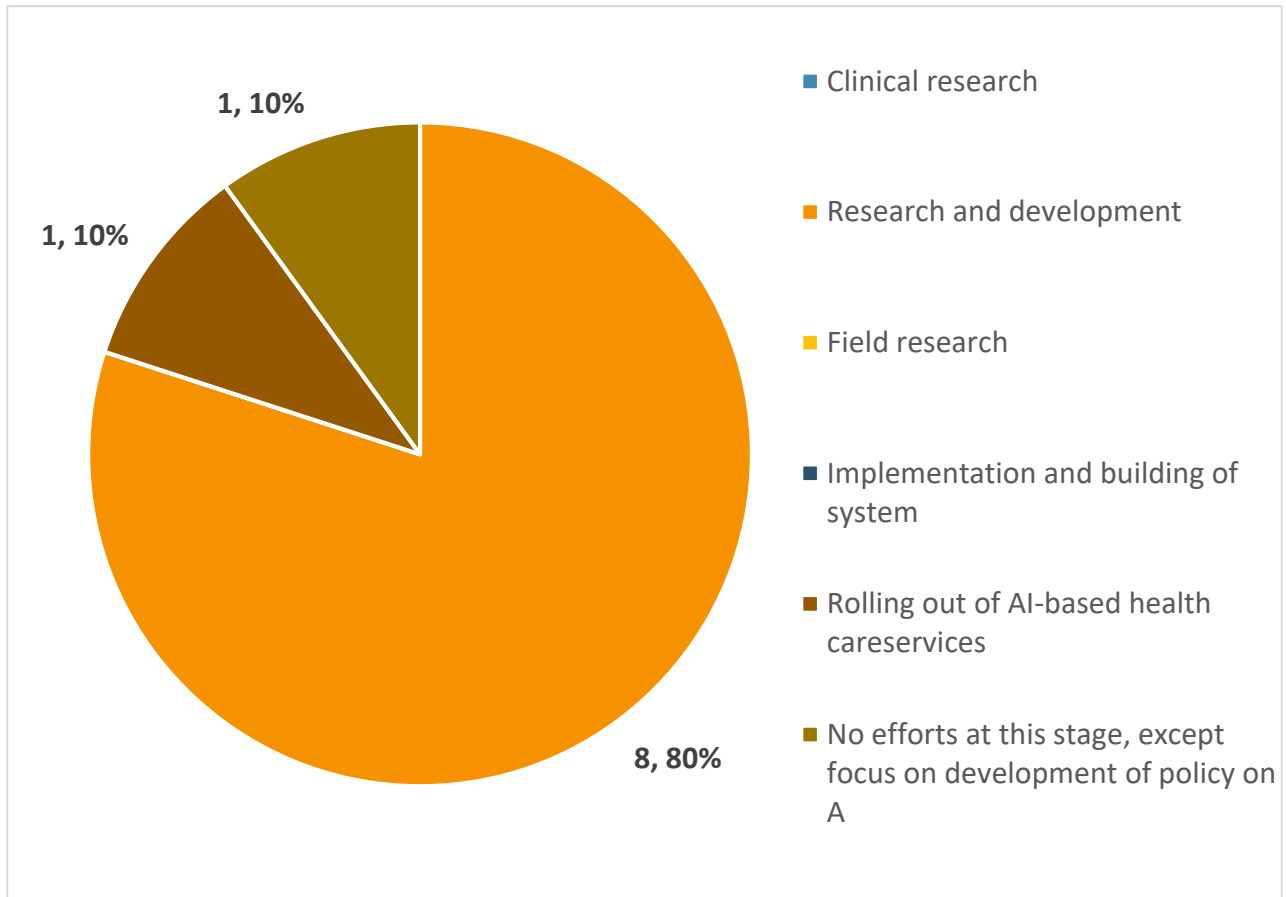
14. Following question 13, please specify the non-government organizations that have involved in such a project.

Economy area	Department(s) of the official authority/government
Indonesia	Indonesian Artificial Intelligence Society
N/A	Private sectors, healthcare starts-up
N/A	Centro Nacional en Sistemas de Información en Salud (CENS Chile)
N/A	Academic institutions

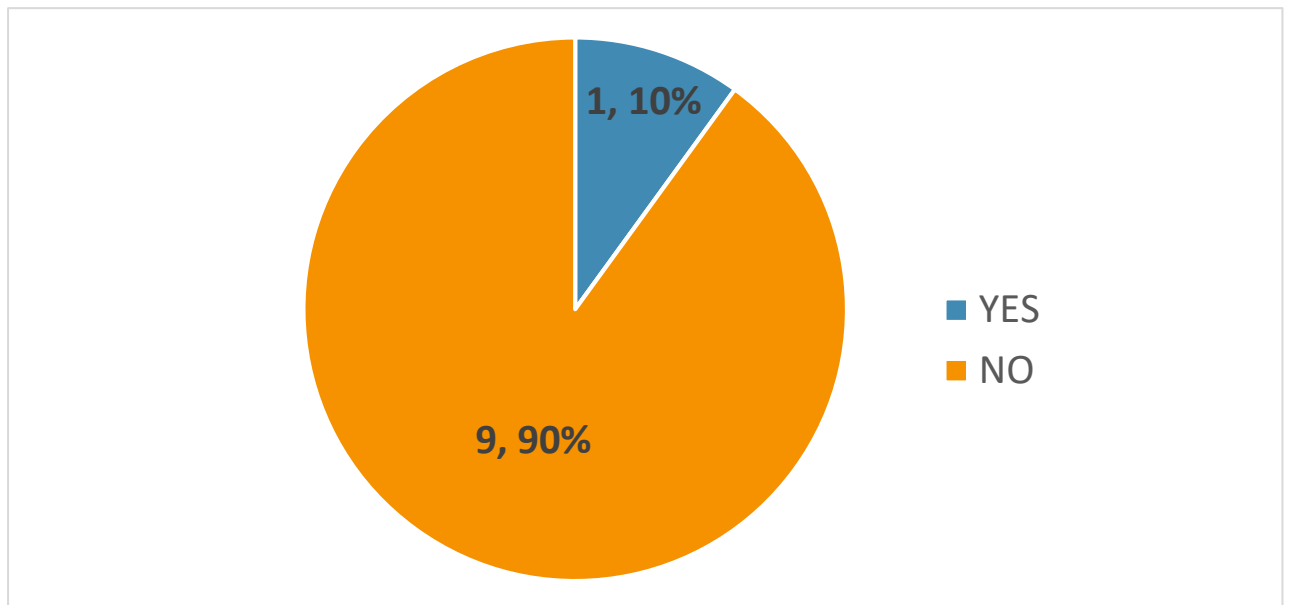
15. Is there funding and support provided by the official authorities/government in your economy/area to facilitate the development of AI-based healthcare services?



16. Following question 15, what aspects of AI-based healthcare services have been covered by the support from the official authorities/government in your economy/area? (multiple choice)



17. Is there one-stop service provided by the official authorities to facilitate the development and implementation of AI-based healthcare services in your economy/area?



18. Are there success stories on the implementation of AI-based healthcare services in your economy/area?

N/A

19. Is the implementation of AI-based healthcare services supported by the policy of official authorities in your economy/area? Please specify.

Economy area	obstacles regarding the implementation of AI-based healthcare services
Papua New Guinea	No existing domestic policy on AI
Malaysia	Implementation of Emerging Technology including AI (not specifically for healthcare) is mentioned in Malaysia Digital Economy Blueprint published by Economic Planning Unit, Prime Minister Department in February 2021
Malaysia	The Malaysia AI Roadmap is still being developed by the government
A regional economic forum to leverage the growing interdependence of the Asia-Pacific	Yes, many researches of AI-based healthcare services already get support from Government, for example: Hallo doc

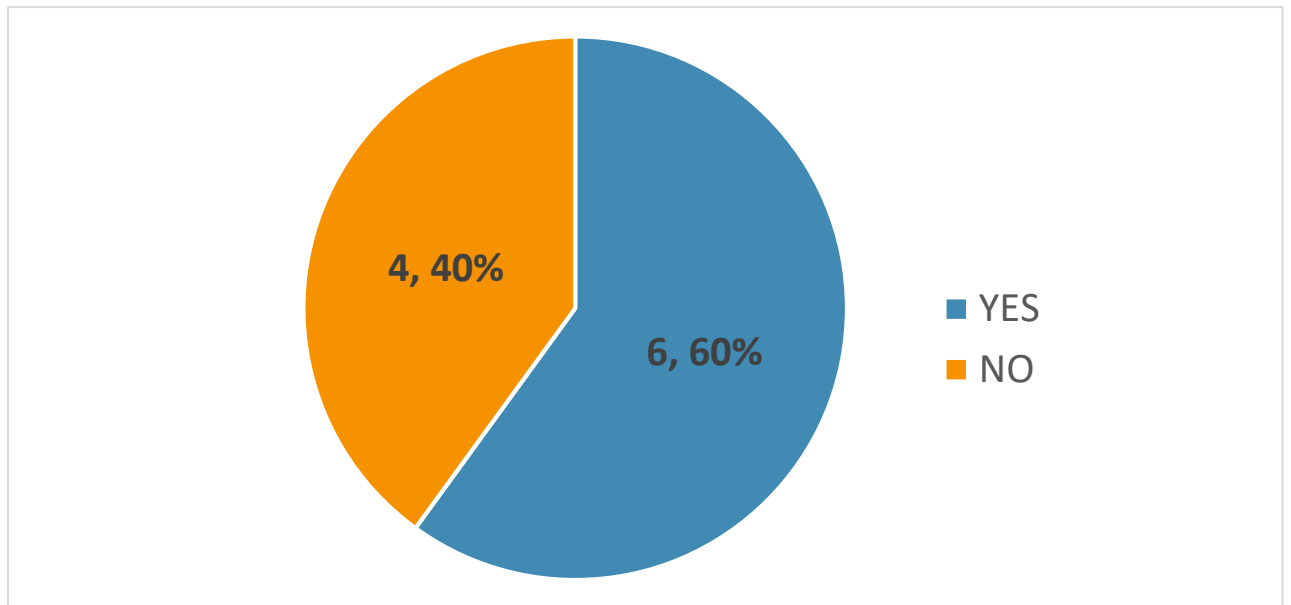
20. Are there any obstacles regarding the implementation of AI-based healthcare services in your economy/area? Please specify.

Economy area	implementation of AI-based healthcare services supported by the policy of official authorities in your economy/area
Papua New Guinea	No obstacles other than need to formulate domestic AI policy to facilitate AI-based healthcare services
Malaysia	Lack of regulation
Malaysia	<p>Yes.</p> <ol style="list-style-type: none"> 1. Lack of thought leadership & commitment to invest on AI initiatives and anything important to support it; 2. Lack of support in terms of capacity building and continuous learning in AI; 3. Lack of adequate infrastructure and tools to develop actionable insights.
A regional economic forum to leverage the growing interdependence of the Asia-Pacific	Funding and human resources are the most obstacles
Thailand	Unclear regulatory pathway, low acceptance rate in some groups of healthcare professionals, lack of usability study in the design process
Chile	Yes. IT Infrastructure including internet connectivity

21. Supported by APEC, a webinar on Digital Healthcare will be held by Chinese Taipei in cooperation with the APEC economies on 11st and 12nd August, 2021. The main objective of this conference is to propose a framework articulating the policy and technology to facilitate the digital transformation of healthcare system by using AI for APEC economies with the considerations on the issues of regulation and implementation. In this context, your suggestions on the issues and themes to be covered in this conference is highly appreciated. Please provide your suggestions in the following dialog window.

Economy area	suggestions
Papua New Guinea	Support for a broad domestic AI policy
Malaysia	Ethical consideration in AI based healthcare and the need (or not) regulation for AI in healthcare
Malaysia	The AI framework to cover on governance, policy and guidelines on how to institutionalize AI, such as guide on how data to be used for AI, possible implication of actions/decision made using AI, how to foster education on AI etc.
Thailand	Approval and ethical consideration systems
Philippines	Policy must support the minimum requirements for local capacities (infrastructure, competency, and resources) on the use of AI in healthcare. An acceptable standards must be define to be observed by the APEC economies to advance their AI implementation.
Philippines	The use of AI in medical decision making: Use cases in the ASEAN region

22. Is it possible to share your suggestions and experiences with us through an interview by the personnel of Chinese Taipei?



References

1. APEC Business Advisory Council. 2020. Artificial Intelligence in APEC.
2. Hawgood, S., Hook-Barnard, I. G., O'Brien, T. C., & Yamamoto, K. R. 2015. Precision medicine: beyond the inflection point. *Science translational medicine*, 7(300), 300ps17-300ps17.
3. Gambhir, S. S., Ge, T. J., Vermesh, O., & Spitler, R. 2018. Toward achieving precision health. *Science translational medicine*, 10(430).
4. Aguado, B. A., Grim, J. C., Rosales, A. M., Watson-Capps, J. J., & Anseth, K. S. 2018. Engineering precision biomaterials for personalized medicine. *Science translational medicine*, 10 (424).
5. He, J., Baxter, S. L., Xu, J., Xu, J., Zhou, X., & Zhang, K. 2019. The practical implementation of artificial intelligence technologies in medicine. *Nature medicine*, 25(1), 30-36.
6. Laubenbacher, R., Sluka, J. P., & Glazier, J. A. 2021. Using digital twins in viral infection. *Science*, 371(6534), 1105-1106.
7. Seyfert-Margolis, V. 2018. The evidence gap. *Nature biotechnology*, 36(3), 228-232.
8. Babic, B., Gerke, S., Evgeniou, T., & Cohen, I. G. 2021. Beware explanations from AI in health care. *Science*, 373(6552), 284-286.
9. Eshete, B. 2021. Making machine learning trustworthy. *Science*, 373(6556), 743-744.
10. Agrawal, R., & Prabakaran, S. 2020. Big data in digital healthcare: lessons learnt and recommendations for general practice. *Heredity*, 124(4), 525-534.
11. Kraus, S., Schiavone, F., Pluzhnikova, A., & Invernizzi, A. C. 2021. Digital transformation in healthcare: Analyzing the current state-of-research. *Journal of Business Research*, 123, 557-567.
12. Benis, A., Tamburis, O., Chronaki, C., & Moen, A. 2021. One Digital Health: A unified framework for future health ecosystems. *Journal of Medical Internet Research*, 23(2), e22189.