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I MAMMOGRAPHY ACCEPTANCE WITH INSIGHTS FROM PATIENT AND HEALTHCARE PROFESSIONAL USING UTAUT

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Abstract

Breast cancer currently positioned as the leading cause of cancer-related mortality among women in Indonesia, highlighting the urgent need for early detection and accurate diagnosis. AI-assisted mammography is one of a potential solution to detect the cancer early and reduce radiologist workload. However, the adoption of AI mammography remains limited, due to skepticism among healthcare professionals, and a lack of patient awareness. This study aims to evaluate the acceptance of AI mammography using the Unified Theory of Acceptance and Use of Technology (UTAUT) framework, by incorporating insights from both healthcare professionals and female patients aged 30 and above. A mixed-method approach was employed, quantitative surveys from 480 women and interviews 8 healthcare professionals. The results indicate that Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions significantly impact Behavioral Intention to adopt AI mammography. However, the relationship between Behavioral Intention and actual Use Behavior did not meet reliability and validity thresholds, suggesting that adoption is still in its early phase. Key barriers identified include limited AI exposure, infrastructure disparities, regulatory constraints, and concerns over job displacement among radiologists.

Keywords: ***Mammography, Breast Cancer, UTAUT, Technology Adoption, Crossing The Chasm, Innovation Management***

1. Introduction

Cancer is third cause of death in Indonesia, after stroke and heart disease. This statement also supported by Globocan data, in Indonesia only there were 408.661 new cases with 242.099 death in 2022. The highest contribution is from breast cancer for female while lung cancer for male populations (IARC, 2022). Responding to the situation Indonesian government are focusing on 5 types cancer and breast cancer is one of them. This was also because of the burden of cancer on finance health system in Indonesia (BPJS) continue to increase from ninth position in 1990 to 2nd position in 2019 (Kementrian Kesehatan Indonesia, 2024b). Ministry of Health argue that the situation got worse because of the lack of diagnostic examinations, and innovative treatments for the type of cancer that can be covered by the JKN Program. Government initiatives expected to be an effective anticipatory step to manage cancer's mortality and incidence which predicted to increase in the future.

As a commitment to this, The Ministry of Health as the executing agency for IHSS project has applied for joint co-financing project with World Bank (WB) and Islamic Development Bank (IsDB) create a collaboration project called IHSS (Indonesia Health Systems Strengthening) Project (World Bank Group, 2024).One of the packages is procurement, installation, operational support and maintenance of approximately 361 unit of Mammography equipment that will be delivered, installed at various level of hospital facilities across Indonesia (Kementrian Kesehatan Indonesia, 2024). Goals for the modernization of the health system across the country are not only to increase the survival rate of Indonesia's cancer patient, but also as a control strategy (early detection and effective treatment) and cancer prevention. The issue of survival rate is quite significant, because comparing survival rates after 5 years starting therapy in high-income countries exceed 90%, in India 66%, in South Africa 40% (WHO, 2023) while for Indonesia (for time span 2016-2021) 56.8%.

Based on WHO's Global Breast Cancer Initiative (GBCI) report, there are 3 pillars of action to control cancer: health promotion for early detection, timely breast diagnosis and comprehensive breast cancer management (WHO, 2022).

The primary factor that contributing to the high rate of mortality in breast cancer is lack of early detection (Icanervilia et al., 2023; Parsa et al., 2006). This situation leads Indonesia's mortality rate to survive breast cancer higher even exceeds the global average (Coleman et al., 2008). Mammography is considered as the most effective screening method which lower the mortality rate by 20- 30% (Fletcher & Elmore, 2003).

As the technology advancement, the healthcare industry increasingly adopting artificial intelligence (AI) to improve the accuracy and efficiency (Hua et al., 2024). In study, the focus is in Diagnostic Imaging, Radiography and Mammography to be specific. In mammography itself, AI expected to enhance early breast cancer detection rates, reduce diagnostic errors and lower operational costs. However, the adoption of AI mammography in Indonesia faces significant resistance. In the process of digging more about the issue, there are several stakeholders that involved which impacting the lack of enthusiasm of adopting the technology. The analysis is described in the following figure:

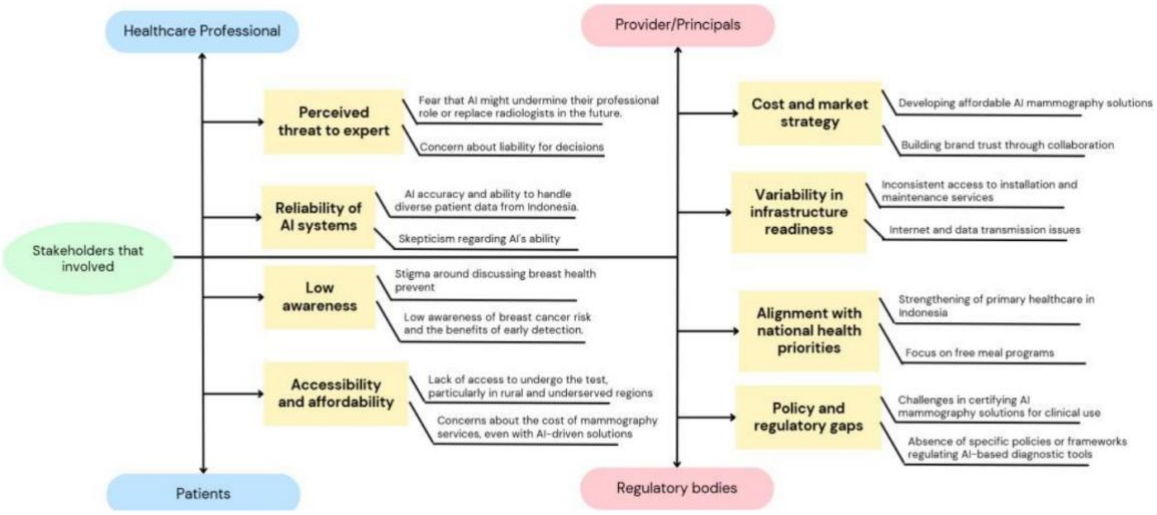

Figure 1. Possible Issue To AI Mammography Adoption Based on Stakeholder's Perspective

The observation revealed, despite the potential, healthcare system in Indonesia is still reluctant to adopt the technology. Additionally, the situation may lead to providers/principles at a competitive disadvantage. Companies like Siemens Healthineers, General Electronic, Philips, Canon delaying the market growth and reducing opportunities for technological refinement through real-world feedback, moreover since they are forced to offer less advanced tools to match local market readiness resulting technological edge of the company are lost compared to another region. To summarize, it is very critical to address adoption barriers of AI Mammography to secure both provider competitiveness and national healthcare advancement. By analyzing perspective from patient and healthcare providers thought UTAUT framework, key influencing factor of adoption AI mammography in Indonesia can be identify.

2. Literature Review

Based on previous research, numerous models/theories was already introduced to understand the acceptance of the technology. These model cumulatively explained 40% of the variance in technology use intention. Theory of Planned Behaviour and the Theory of Reasoned Action analyze variable like behavior control, attitude and subjective form make this theory rely more on psychological perspective which give insight as individual' to accepting the technology (Venkatesh et al., 2003). In contrast, Diffusion of Innovation Theory more leaning to the innovation-specific factors that determine users' behavior such as subjective norm, motivational factors, attitudinal factors related to technology performance, social factors, experience and facilitating condition. To provide a holistic understanding of technology acceptance, Venkatesh et al. developing a Unified Theory of Technology Acceptance by integrating behavioral intention and use. Studies and research related to technology adoption has been used widely by varied subject and context. These studies and research important to provide insights and perspectives for this research and especially for healthcare businesses. Below is the list of the previous research and study summary

Table 1: Previous Study

Researcher	Title	Findings

Hua et al., 2024	Understanding the factors influencing acceptability of AI in medical imaging domains among healthcare professionals: A scoping review	Key factors underpinning healthcare professional acceptability of AI are System usage, Socio-organisational, cultural factors, User factors
Perwira, 2024	Evaluasi Penerimaan Wearable Electrocardiograph (Dubdub) Pada Masyarakat Indonesia Dengan Menggunakan Model Penerimaan Teknologi	Lower educational background and older age ranges participant most likely have difficulty to understand the technology.
Yin et al., 2022	User acceptance of wearable intelligent medical devices through a modified unified theory of acceptance and use of technology	After one moth of experience, key factor that influence cognitive perception are hedonic and pragmatic qualities that drive the adoption of AI technology. Significant balance between user friendliness and innovation and highlighted.
Rouidi et al., 2022	TAM-UTAUT and the acceptance of remote healthcare technologies by healthcare professionals: A systematic review	TAM and UTAUT models are still valid and used to predict the acceptance behavior of remote care technologies by health professionals, even if they were not originally formulated to be used in the context of remote care technologies.
Cobelli et al., 2023	Pharmacists' attitudes and intention to adopt telemedicine: Integrating the market-orientation paradigm and the UTAUT	The findings from a survey of 202 pharmacists revealed that market orientation is positively associated with performance expectancy, effort expectancy, and social influence but negatively related to facilitating conditions. These findings have implications for the network of actors involved in the provision of telemedicine services.

3. Methodology

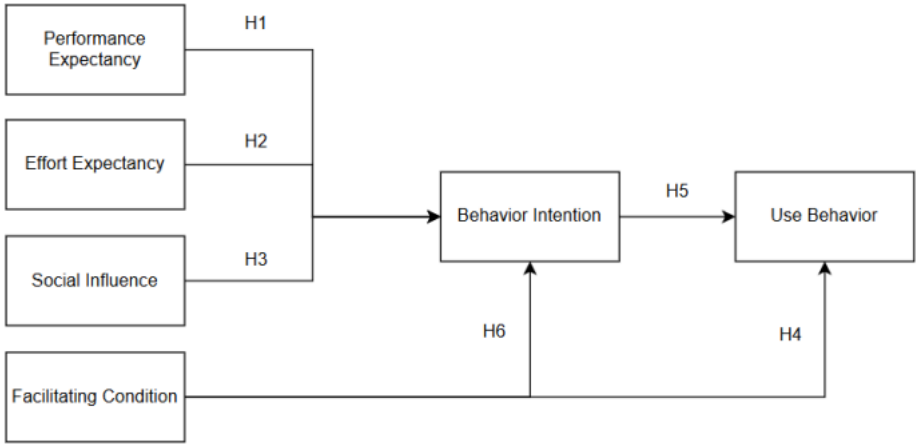

Figure 2. Conceptual Framework

Based on Unifies Theory of Acceptance of Use of Technology (Venkatesh et al., 2003), there are 4 main aspects. Performance expectancy is to characterizes user's confidence that by using technology will benefit the performance of their works. Effort expectancy represent user's belief of how easy to use the technology. Social influence, is describe user decision on using the technology is affect by significant other opinion. Facilitating conditions, represent the external support that enable user to adopt.

H1: Performance expectancy has positive relation to AI Mammography behavioral intention to use.
H2 : Effort expectancy has positive relation to AI Mammography behavioral intention to use.
H3 : Facilitating condition has positive relation to AI Mammography behavioral intention to use.
H4 : Social influence has positive relation to AI Mammography behavioral intention to use.
H5: Facilitating Condition has a significant positive influence on Use Behavior.
H6: Behavioral Intention has a significant positive influence on Use Behavior.

Author used a questionnaire survey with 3 sections to test the model. First section is regarding the demographics information regarding the respondents. Second section was assessed the state of understanding of Mammography and AI Mammography. Third section was questions for various construct in research model, with by likert scare 5-points with answer range from strongly disagree to strongly agree. The respondent was focus on woman with age above 30 that currently reside in JABODETABEK area. This demographic was chosen because screening of mammography is only recommended to people above 40 years old, due to the density of breast tissue. JABODETABEK is consider as major urban cities in Indonesia which have more access to advance healthcare system with diverse population which make this to an ideal location.

The qualitative data was done by focusing only on healthcare professional population. The focus of the qualitative interviews is considered strategic because they play a critical role in the adoption and implementation of AI- assisted tools within clinical settings. Healthcare professionals, including radiologists, and clinicians, are the primary users and decision-makers in integrating AI into diagnostic workflows. Their perspectives provide valuable in-depth insights into practical considerations. The objectives of the interview is to understanding the clinical relevance and feasibility of AI integration, including how it fits into existing workflows and enhances diagnostic accuracy and efficiency, understanding challenges and barriers, and how AI impacts patient-provider interactions. By focusing on this group, author able to complementing patient-focused quantitative data and providing a comprehensive understanding of the factors influencing AI adoption.

This research uses convenience sampling, selecting participants who are easily accessible and convenient for the researcher. In total there are 8 interviews with healthcare professional. To ensure a diverse range perspective on AI-assisted tools, the participant of the interview can be seen as in the table below. The interviews were done using semi-structured interview method, where author prepared a set of list of topics and questions that need to be discussed. Participants will be interviewed directly through one-on-one personalized conversations, and several interviews also conducted via Online Meeting. Questions that were used for the personalized interview was an open-ended to allow participants to provide detailed responses. The list of healthcare professional that was interviewed are: 1 General Practitioner, 2 Radiographer, 2 Radiologist, 1 Pediatrician, 1 Opthalmology Resident, 1 Plastic Surgery Resident

4. Discussion and Analysis

Patient Perspective

The sample characteristics are presented in table 2. Out of 480 respondent only 28.3% that had mammography screening through out their life, with 27.2% was undergo the test because current conditions like abnormalities, doctor recommendations and follow-up post treatment/follow-up from previous abnormalities.

Table 2: Demographic of Patient

Demographics		n=480
Age	31-35 years old	12.1%
	36-40 years old	37.5%
	41-45 years old	28.3%
	46-50 years old	10.8%
	51-55 years old	6.3%
	> 55 years old	5%
Educational Level	High School	30.4%
	Bachelor	62.5%
	Master	6.9%
	Doctorate	0.2%
Experienced Mammography	Yes	28.3%
	No	71.7%

Reason Why Undergo Mammography	Screening	72.8%
	Other condition	27.2%

To evaluate the relationship between observed and latent variables SmartPLS 3.29 is used. This particular method is suitable for predictive and exploratory research to examine which factor influencing adoption of the technology. In the context of this, as the author use UTAUT model. The construct result show that Cronbach Alpha, CR Value and AVE Value for User Behavior are -0.392, 0.345 and 0.357 respectively. These values are not meeting the minimum criteria, means the construct are not effectively measured, highly due to participants' limited familiarity with AI mammography as the technology now only available in one hospital in Jakarta. Author decide to refine the measurement items, and focus on Behavioral Intention since the actual usage remains limited. The adjustment was made to reflect the realities of the study's participants and research context, due to participants are unlikely to have experience with AI mammography makes Behavioral Intention more appropriate focus as a strong predictor of future use in early adoption. In the new construct, Facilitating Condition become an input to Behavioral Intention since it shape patients' trust in the system's ability to protect their personal and medical data when using AI technology, and awareness of informed about AI mammography that patient can access.

After the adjustment was made, the measurement of new model demonstrates reliability and validity across constructs. Overall, all the indicator loadings meet the recommended threshold and no item needed to be removed. Outer loading represent the correlation between item and construct, the analysis show all outer loading are passed 0.7 which demonstrating strong indicator reliability (ranged 0.779- 0.91). Composite Reliability (CR) measure overall reliability of the construct by ensure internal consistency among items. Result showing reliability across construct (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition and Behavioral Intention) are consistent, proven by the value exceed 0.7 (ranged 0.875-0.927). Cronbach's Alpha, evaluate how each item measure the same concept. Result ranged from 0.788-0.899 confirm that the internal consistency for all construct are acceptable, based on theory the score must be more than 0.7 to be acceptable. Lastly, Average Variance Extracted (AVE Value) are exceed 0.5.

The discriminant validity, Fornell-Larcker criterion was applied. Discriminant validity was analyze to confirming that each construct captures a unique aspect of the data. Table below, shown the square root of AVE for Behavioral Intention, Facilitating Condition, Perceived Ease of Use, Perceived Usefulness, Social Influence are 0.873, 0.872, 0.837, which is higher than its correlations with other constructs. (0.844), and (0.837) also satisfy the Fornell-Larcker criterion, with their square root of AVE values being greater than the correlations with other constructs. After confirming the validity of all measured indicators and constructs, the model was assessed using R2 for the endogenous constructs for Behavioral Intention. R2 values vary from 0 to 1, which the greater the number, the better the predicted accuracy. The value shown is 0.763, means 76.3% of the participants' intention to adopt AI mammography is influenced by measured factors like Facilitating Condition, Performance Expectancy, Effort Expectancy and Social Influence. The remaining 23.7% are other factors that influenced the participant but not included in model. Other aspect that needs to be check is the cross loading, which demonstrated discriminant validity with each indicators are corresponding to the construct. The results confirm the uniqueness and reliability of the constructs, validate each latent variable is represented by its indicators.

Healthcare Professional Perspective

This study aims also to explore the factors that influence healthcare professionals' reluctance to adopt the AI technology in diagnostic imaging focusing on perceived as threats to expertise and concern on the technology reliability. Eight (8) participants with diverse professional backgrounds were selected to ensure comprehensive understanding. Radiologist and radiographers are choose as the representation of professionals that engaged directly in imaging and diagnostic. General Practitioner was included to provide a broader perspective on how AI integrate in general clinical practices and primary care, not to mention that the Mammography is mainly used as a early detection step before any symptoms appear. Other specialties, Ophthalmologist Residence, Plastic Surgery Residence and Pediatricians are involved even they are not direct user but they support valuable insights like fresh perspective as representation of Indonesian future workforce, and broader implication of AI in patient care in interdisciplinary context.

Table 3: Demographic of Healthcare Professional

Participants	Gender	Age (years)	Domicile

Radiographer_1	Female	24	Jakarta
Radiographer_2	Male	27	Jakarta
General Practitioner_1	Male	28	Jakarta
Ophthalmologist Residence_1	Female	30	Aceh
Plastic Surgery Residence_1	Female	28	Surabaya
Pediatrician_1	Female	37	Depok
Radiologist_1	Female	46	Jakarta
Radiologist_2	Female	47	Bandung

Based on the interview result, almost all of the healthcare professionals acknowledge the potential benefits of AI in diagnostic imaging particularly in minimizing error, reduce workload and improve efficiency. AI may served as a valuable second opinion to assist abnormalities that may be overlooked and will be very helpful for cases during COVID-19 for example, where the load of the work is high. Additionally, AI's ability to prioritize critical cases and levelling cancer seen as an advantage in busy hospital. Despite the expectation, respondent also expressing their concern regarding AI may replace the expertise and role of doctors, they really pressing point on 'retain control over final diagnoses by radiologist'. They believe that the role of AI is more to supporting clinical decision-making rather than replacing radiologist.

AI mammography may improve the current workflow, however there are still challenges regarding the compatibility with the current system that's been running in the hospital and it will take a while for both radiographer and radiology to get use and be familiar with the AI features. The Radiographer_2, Periatrician_1 and General Practitioner_1 admit that currently their exposure to any type of AI are still limited, which contribute to the uncertainty and hesitation to adopt the technology. Furthermore, the lack of AI training or any AI awareness program was one of the biggest barrier to adopt. The ophthalmology resident emphasize on this issue which highlight the need of hands-on training and strategy to familiarize AI mammography before fully integrated to clinical practice. 7 out of 8 respondents admit that they've never seen or experiencing any AI diagnostic imaging demonstration, suggesting educational campaigns would be very helpful to increase the awareness. Another concern is about regulatory approval and which government entity that validating the result of AI.

This suggest that official endorsement from Indonesia's medical authorities would strengthen confidence in AI-Based diagnostic as Radiologist_1 stated In terms of social influence, the key stakeholder including policymaker, hospital management, radiologist association are play a crucial role. Ministry of health, in this case as the government agencies, should be able to set the AI regulation or incentives like in the case of EV car. As for the hospital management, finance and procurement department is the key player since they most likely to buy tools that is more urgent, based on what they currently need or based on the capacity of their budget. Senior radiologist and key opinion leader in the field (radiologist association) significantly influence that purchasing decision, which explained by Several barriers to the adoption are identified, however the regulatory and legal uncertainties are the most significant one. As Radiologist_1 and Plastic Surgery Resident_1 mention that, currently AI lacks a standardized approval, any big player to startup able to promote their product but they are not sure since there are no guidelines from government. Other points regarding barrier is uncertainty regarding liability and responsibility in AI assisted misdiagnoses which addressed by Pediatrician_1 and Radiographer_2.

Financial constrain also emerged as one of the major barrier, particularly for BPJS-affiliated hospital. A hospital that almost 80% of the patient are relying on BPJS struggle to justify the cost of AI investment. On the other hand, private hospital seen more open to AI investment especially if the technology proven improve operational efficiency and patient throughput. Another issue is data privacy and the strict handling of patient imaging data which may increase complexity of compliance. Radiographer_2 expressed their concern regarding job security which reflect a broader fear of AI disrupt the expertise of radiologist. Patient acceptance of AI remain an important consideration, since the quantitative survey result showing many respondents indicate patient are willing to try the technology. However, the interview result is quiet difference, Radiographer_2 and Ophthalmologist Resident_1 responsed that patient generally trust result that analyze by human instead of AI and maybe the adoption of AI-tools may not as impactful to the public perception.

5. Conclusion

By incorporating insights from healthcare professionals and female patients aged 30 and above, the research provided a comprehensive understanding of the key factors influencing AI mammography adoption. The mixed-method approach, which included quantitative surveys from 480 women and qualitative interviews with eight healthcare professionals, enabled a holistic analysis of both user expectations and professional perspectives on the technology. The findings indicate that Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions significantly impact Behavioral Intention to adopt AI mammography.

This suggests that women and healthcare professionals are more likely to adopt AI-assisted diagnostics if they perceive tangible benefits, ease of use, peer influence, and institutional support. However, the relationship between Behavioral Intention and actual Use Behavior did not meet reliability and validity thresholds, indicating that the technology is still in its early adoption phase, with limited real-world exposure and usage. Several barriers to adoption were identified, including skepticism among healthcare professionals, concerns over job displacement, infrastructure disparities, regulatory constraints, and a lack of AI awareness and training. These challenges indicate that, while AI mammography presents great potential in improving early breast cancer detection and diagnostic efficiency, its successful adoption requires a structured implementation strategy.

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