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# Needs Analysis for Competence of Information and Communication Technology for Medical Graduates

Afifah Vardhani[1], Ardi Findyartini[2,3], Mardiastuti Wahid[2,3,4]

[1]*Medical Education Master Programme, Faculty of Medicine, Universitas Indonesia, Jakarta, INDONESIA*

[2]*Department of Medical Education, Faculty of Medicine, Universitas Indonesia, Jakarta, INDONESIA*

[3]*Medical Education Center, Indonesian Medical Education and Research Institute, Faculty of Medicine, Universitas Indonesia, Jakarta, INDONESIA*

[4]*Department of Clinical Microbiology, Faculty of Medicine, Universitas Indonesia, Jakarta, INDONESIA*

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## ABSTRACT

Medical technology is instrumental to improve the services provided to patients, including those in middle-income countries. However, to date, medical information and communication technology (ICT) competencies have not been clearly elaborated and standardised. Thus, this study aimed to analyse the need to strengthen ICT competence for medical graduates in the Indonesian context. This work involved focus group discussions (FGDs) with 28 doctors and 12 clinical-year students, as well as in-depth interviews with four stakeholders. The data were transcribed, coded and interpreted using thematic analysis approach. The results reveal three salient themes: the use of ICT in healthcare and health education, the challenges involved in the use of ICT and the competencies in health ICT needed by medical graduates. Aspects of technical competence include the abilities to evaluate and utilise technology based on patients' needs, build relationships with patients using technology, convey education through ICT and maintain data security and prevent its misuse. Intellectual, analytical and creative aspects include the abilities to apply biomedical and clinical sciences in the utilisation of medical ICT, employ evidence-based technology (evidence-based practice) and process and use data for the benefit of patients. Personal and professional aspects include the abilities to apply professional ethics and collaboration in using ICT, maintain patient confidentiality and adapt to technologies. The ICT competencies identified in this study can be used to develop and revisit the undergraduate medical curriculum.

**Keywords:** *Competence, Curriculum, ICT, Medical education, Medical technology*

## CORRESPONDING AUTHOR

Ardi Findyartini, Department of Medical Education, Faculty of Medicine, Universitas Indonesia, Jalan Salemba Raya No. 6, 10430 Central Jakarta, Indonesia

Email: ardi.findyartini@ui.ac.id

## INTRODUCTION

Medical technology developments are used by various health disciplines to improve the services delivered to patients (1). For doctors, technology assists in providing health consultation services, developing diagnoses, determining appropriate treatments, monitoring patient health, managing data and analysing healthcare plans. For patients, technology provides benefits in terms of convenience in accessing health information and services, saving waiting time in health facilities, increasing knowledge on health issues, obtaining comprehensive services with an integrated system (2, 3) and having greater autonomy in determining the health services that they need (4). Therefore, in navigating the use of technology in healthcare, medical graduates should possess the necessary competencies for technology-enhanced healthcare and practice.

Competency-based medical education (CBME) underlines the importance of making expectations of our education more concrete, visible and relevant for students (5, 6). Competencies consist of knowledge, skills and attitudes that describe the abilities to be achieved by a medical doctor. In describing the expected abilities, Harden et al. (7). categorised them into three circles, as depicted in Figure 1. Various competency frameworks have been introduced globally, including the Accreditation Council for Graduate Medical Education (ACGME), CanMeds and Entrustable Professional Activities (EPAs). The ACGME (8) proposed six areas for medical doctors' competencies, including patient care, medical knowledge, practice-based learning and improvement, systems-based practice, professionalism and interpersonal communication skills. In addition, CanMeds suggested a series of general attributes of better physicians: medical expert, communicator, collaborator, leader, health advocate, scholar, and professional (9). Meanwhile, a more advanced competency-based framework, EPAs, is defined as units of a professional activity requiring adequate knowledge, skills and attitudes, with a recognised output of professional work, independently executable within a time frame, observable and measurable in its process and outcome and reflecting one or more competencies (10).

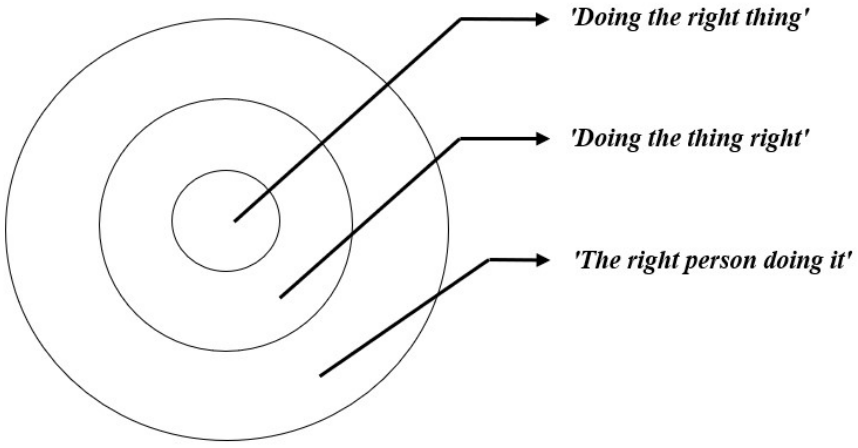


**Figure 1:** Correlation among self-efficacy, parenting style and academic performance.

The descriptions of the competencies adapted to the Dundee three-circle framework (7) are as follows:

1. "Technical competence" refers to the technical abilities that a doctor must be able to perform, including technical mastery, effective communication and data security ("doing the right thing").
2. Intellectual, analytical and creative approaches taken by a doctor during actual clinical practice, including having basic knowledge of clinical and biomedical sciences, evidence-based practice and data management ("doing the thing right").
3. Personal and professional aspects that show the role of a doctor as a professional with personal intelligence, covering the areas of ethics, patient confidentiality and lifelong learning ("the right person doing it").

This study selected Harden's framework for competency due to its broad applicability, which allowed to explore relevant competencies in information and communication technologies (ICTs) for medical graduates. This framework can also be adapted to the needs of curriculum development. In Indonesia, for example, it is tailored to advancements in medical science and technology and to community needs for quality assurance in medical education as the initial step in achieving patient safety in practice (11). Medical graduates are expected to be able to utilise and analyse data to inform, convey and improve health degrees and practices at the individual, group or system levels ("doing the thing right"); to achieve the goals and benefits of health technologies and systems implemented on a local, regional or national scale, including legal, policy and ethical considerations ("the right person doing it"); and to participate in the implementation of digital health, evaluation and collaborative system design processes to stimulate positive changes and integrate digital health into clinical practices to deliver safe and high-quality services, including best practice models ("doing the right thing") (12). The identification of ICT competencies for medical doctors working in the healthcare, research and education fields must consider the local context.

ICT competencies should be integrated well into the medical curriculum. Nguyen et al. (13) reported the need to improve healthcare, health, and well-being by reconstructing the medical curriculum in Vietnam through the integration of ICTs. Yeoh (14) offered insights into Malaysian medical education and its digitalisation. In Singapore, Zainal et al. (15) reported that medical students would benefit from a curriculum that teaches them to use digital technologies alongside core clinical skills. Brunner et al. (12) conducted a literature review and cross-faculty discussion groups, which resulted in the formulation of ICT competencies that health workers must master regarding existing systems and policies in Australia.

As for other countries in Southeast Asia and Oceania, Indonesia is currently using ICTs to improve its medical services. However, the ICT competencies of Indonesian medical graduates have not been developed comprehensively despite the government's focus on these competencies in the national standard. Considering the diversity and resources in Indonesia, the current study was conducted to explore and analyse the need for ICT competencies for medical graduates in this country. The process of analysing such needs aimed to identify the competencies that must be attained by a group of targeted learners (7). The results are expected to elaborate the ICT-related competencies which should be achieved by medical graduates and to inform the development of the medical curriculum.

# METHODS

## Context

Indonesia, an archipelago country located in Southeast Asia, has the world's fourth largest population (16). As a middle-income country, the trend of health services in Indonesia now involves the use of online health information portals for the public, big data, immersive technologies, wearable devices, artificial intelligence (AI), blockchain and electronic medical records (eMRs) (2). To improve the health system in Indonesia, the Ministry of Health has implemented policies to transform health technology in the country, including the integration and development of data, health systems and health service application systems, as well as the development of health technology ecosystems (11). Therefore, Indonesian medical doctors are required to adapt promptly, carry out transformations and improve their professional competences. Indonesian doctors must develop their ICT competences due to the ever-evolving trend of medical technologies (17). In relation to such development, medical students must be equipped with concepts and principles behind the use of technologies in healthcare, research and education, rather than focusing only on technical knowledge to ensure the retention of their core medical skills (15). Medical students must also understand and evaluate the benefits and limitations of the use of technologies, including digital devices (18).

## Study Design

This is a qualitative descriptive study. Qualitative descriptive studies are used to obtain specific data to describe and explore available concepts or theories within a certain context. This method involves data collection to determine the important components (who, what and where) of an event or experience using a naturalistic perspective. The result is a descriptive summary of an event, which is processed and presented in the form of relevant data (19). The data collection methods conducted in this study included focus group discussions (FGDs) and semi-structured interviews. The research was conducted from May to June 2023.

## Data Collection

The selection of participants in the FGDs considered aspects of different group configurations to explore various ideas and insights using relevant FGD questions. Variation was ensured in each group using the maximum variation sampling technique based on gender, place of employment, regions in Indonesia (from Sumatra to Papua), work experience and age group (X, Y, and Z generations). The FGDs were organised into the following groups: (1) practicing medical doctors not working in educational institutions (n = 10); (2) medical doctors in charge of health management (n = 8); (3) medical doctors as researcher, educators or lecturers (clinical and biomedical sciences) (n = 10); and (4) medical students completing the clinical stage (n = 12). The characteristics of the FGD informants are listed in Table 1.

**Table 1:** Characteristics of the FGD informants (n = 40)

| FGD code | Respondent code | Gender | Characteristic |
|---|---|---|---|
| S[1] | D1 | Male | Paediatrician |
| | D2 | Male | General Practitioner (GP) |
| | D3 | Male | GP |
| | D4 | Male | GP |
| | D5 | Male | GP |
| | D6 | Female | GP |
| | D7 | Female | Ear, Neck, and Throat (ENT) specialist |
| | D8 | Male | GP |
| | D9 | Female | GP |
| | D10 | Female | Dermato-Venereology (DV) specialist |
| D[2] | D1 | Female | Primary care manager (Java Island) |
| | D2 | Female | Hospital manager (Sumatera Island) |
| | D3 | Male | Hospital manager (Wakatobi Islands) |
| | D4 | Male | Hospital manager (Bali Island) |
| | D5 | Male | Hospital manager (Java Island) |
| | D6 | Male | Hospital manager (Java Island) |
| | D7 | Male | Ministry of Health |
| | D8 | Female | Ministry of Health |
| T[3] | D1 | Male | Clinical teacher (Java Island) |
| | D2 | Male | Researcher at the Indonesian National Research and Innovation Agency |
| | D3 | Female | Medical education expert (Java Island) |

(*Continued on next page*)

**Table 1:** (*Continued*)

| FGD code | Respondent code | Gender | Characteristic |
|---|---|---|---|
| T[3] | D4 | Male | Clinical teacher (Java Island) |
| | D5 | Male | Biomedical teacher (Java Island) |
| | D6 | Female | Biomedical teacher (Java Island) |
| | D7 | Male | Medical education expert (Lombok Island) |
| | D8 | Female | Medical education expert (Borneo Island) |
| | D9 | Male | Biomedical teacher (West Papua) |
| | D10 | Female | Technology enhanced learning developer |
| E[4] | M1 | Female | Medical student year V |
| | M2 | Male | Medical student year V |
| | M3 | Female | Medical student year V |
| | M4 | Female | Medical student year V |
| | M5 | Male | Medical student year V |
| | M6 | Male | Medical student year V |
| | M7 | Male | Medical student year VI |
| | M8 | Female | Medical student year VI |
| | M9 | Male | Medical student year V |
| | M10 | Male | Medical student year V |
| | M11 | Female | Medical student year V |
| | M12 | Female | Medical student year V |

Notes: [1]Clinical doctors and do not work in educational institutions (n = 10); [2]Doctors in charge of health management (n = 8); [3]Characteristics of doctors as researcher, educator, or lecturer (clinical and biomedical sciences) (n = 10); [4]Medical students of the clinical stage (n = 12).

In addition, semi-structured interviews were conducted with the following policymakers: (1) representative of the Indonesian Medical Council; (2) representative of the Ministry of Health of the Republic of Indonesia; (3) representative of the Association of Indonesian Medical Education Institutions (AIPKI); and (4) representative of the Indonesian Doctors Association. The interviews with the policymakers were conducted separately to allow the interviewer to explore specific perspectives according to the respected policy. These interviews provided a general overview of the relevance and importance of ICT competencies among medical graduates which informed the analysis of the FGD results. Open-ended questions for the FGDs and interviews were arranged based on the research questions used by Brunner et al. (12), Jimenez et al. (20), and Zainal et al. (15). The questions are listed in Table 2.

**Table 2:** FGD and interviews questions

| No. | Question |
|---|---|
| 1 | What devices, applications, or systems related to health ICT do you use in clinical practice/health management/research/education? |
| 2 | What benefits do you/your patients get from using this technology? |
| 3 | How do you assess your ability to use health ICT in your daily activities? |
| 4 | In achieving this ability, how do you learn it? |
| 5 | What obstacles do you encounter in using this technology? |
| 6 | How do you overcome these obstacles? |
| 7 | How to apply technical aspects in the use of technology? |
| 8 | How to apply aspects of science in the use of technology? |
| 9 | How to apply personal and professional aspects in the use of technology? |
| 10 | What skills related to health ICT must be mastered by a medical graduate? |
| 11 | Do these abilities need to be integrated into the medical education curriculum and what is the reason? |

The FGD and interview results were analysed using thematic analysis with the step for coding and theorisation (SCAT) approach (21). All transcripts were further analysed to identify key information, subthemes, and themes. Data reduction was completed to sharpen, select, focus, and organise data so that conclusions can be drawn. Irrelevant data were omitted. In accordance with the qualitative descriptive design, Harden et al.'s (7) three-circle model was used to inform the qualitative data analysis. An independent thematic analysis of the first two transcripts was conducted by two authors (AKV and AF) to identify the initial themes and subthemes. Afterwards, AKV completed all the data analyses. All authors discussed and agreed on the analysis results.

The qualitative data analysis results were presented in the form of narratives relevant to the identified themes and subthemes. The trustworthiness of the interpreted meaning of the qualitative data was verified using the member-checking method to verify the appropriateness of the interpretation according to the respondents' inputs. This method was carried out once all the data were collected so that the researcher could obtain an overview of the entire dataset regarding the need for ICT competence among Indonesian medical practitioners.

Regarding the researchers' positions, AKV served as a lecturer in a new medical school in Indonesia and completed the present study while finishing the Master in Medical Education programme. AKV has also been involved in different initiatives on the use of information and technology (IT). AF and MWH are both senior lecturers and researchers in medical education and have been involved in curriculum development at the national level through the medical school. All authors were aware of their positions and experiences whilst conducting the study and analysing its results.

## RESULTS

This research was conducted to obtain data on medical graduates' ICT literacy competency requirements as a step in the development of an ICT curriculum. Data were obtained from 40 FGD informants and four interviewees consisting of doctors and medical students from different age groups, genders, levels of expertise, institutions, and locations. Data saturation was reached when no new themes were obtained after going through four FGDs and four semi-structured interviews. A thematic analysis of the need for ICT competency and literacy among medical graduates revealed three salient themes: (1) use of ICT in healthcare and health education; (2) challenges in the use of ICT; and (3) competencies in health-related ICT needed by medical graduates.

### Theme 1: Use of ICT

#### *Healthcare and health management*

ICT in the field of medical practice and management is utilised by doctors working in clinics or hospitals. Computers as hardware are still widely employed, and the software used include chat applications, eMRs, medical calculators, AI, telemedicine applications, video conferencing, social media and professional applications.

> Because we are already utilising electronic medical records, we will also save space and reduce double registration and double recording. (D, D8)

AI-based applications were also generated to analyse examination results and data-driven decisions.

> Decisions are determined based on the data presented on the dashboard or generated by analytical tools, both from AI and business analysts. (D, D6)

#### *Medical education*

In the field of education and research, medical ICT is used by educators, researchers and students in the form of gadgets, as well as hardware specifically used for learning, such as mannequins, virtual reality (VR) headsets, anatomy tables, and laboratory equipment.

> [Regarding] VR for emergency simulations, we are developing it for interprofessional use. (T, D3)

The typical software used include video conferencing learning applications, quizzes, instructional videos, apps that assist students in understanding the materials given, valid literature sources and research data processing and presentation applications. For example, learning management systems are typically used to deliver course materials and assessments.

> Every day, I have to answer health-related questions on social media. (T, D5)

AI's ability to summarise important points about health education is also maximised.

> I request AI to generate points of health education, which we will elaborate on later. (E, M8)

### Theme 2: Challenges in the Use of ICT

As reported by the respondents, the challenges in promoting the use of ICT can be divided into two categories: infrastructure constraints and challenges related to human resources. Inadequate network coverage and power supply remains a challenge in remote areas of Indonesia. The other infrastructure constraints include hardware damage and system constraint issues, such as non-standardised data, lack of interoperability, system errors due to overuse and network security.

There exist gaps in human resources (i.e., doctors) as users of technology, and these can be divided into the following: gaps in learning technology, gaps in the ability to utilise technology and ethical violations. The gaps in learning technology are manifested in the different motivations expressed by doctors and learners to study ICT.

> The discrepancy in the user's knowledge becomes a hindrance. (D, D5)

However, some respondents showed their interest in ICT and their ability to learn it. This motivation is demonstrated by a desire to independently learn technology with the assistance of search engines, colleagues or technology and informatics experts.

> Learning by doing, for me is the fastest way of learning. I can search in Google and then try. (T, D8)

The gap in using technology is evident in doctors who have a limited grasp of certain technologies. For instance, older age is still associated with an inability to use technology.

> Especially senior doctors, it's undeniable that some of them may face difficulties with new additional applications. (S, D7)

Ethical violations in using technology are observed when doctors have access to data, which can lead to misuse.

> There is a misuse of service data, which must be controlled through ethical values. On Facebook, we see some excited doctors who immediately upload procedures on social media, which should have ethical and patient confidentiality safeguards. (IN3)

Human resource obstacles can be overcome by providing assistance, offering support from fellow healthcare professionals, providing training and embedding ICT competence development into the curricula.

> I strongly agree with its integration into the curriculum, but perhaps the first question is where the foundation of this curriculum is based. In this case, it certainly leads to KODEKI [Indonesian Medical Code of Ethics]. (S, D1)

## Theme 3: Competencies of Health ICT Needed by Medical Graduates

### *Technical competence ("doing the right things")*

The domain of technical proficiency includes the ability to assess which technologies must be mastered, the consideration of patients' needs, ease of use and maintenance, as well as the future development of those technologies.

> The ability to choose which technology is suitable for the patient's sake, ease of use and ease of maintenance [and] then future development. (IN1)

Mastering the technology needed in patient care includes basic knowledge of computers, eMRs, government-owned information and application systems, as well as the basics of VR and AI.

> There are experts in making virtual reality, artificial intelligence, machine learning and others. At least we only need to know the surface; in my opinion, it is enough. (T, D10)

Effective communication is related to a doctor's ability to build good relationships or rapport with patients, as well as skills in effectively conveying information through ICT.

> Don't let the use of this technology reduce the interaction between patients and doctors. Well, this needs effective communication. Whether when we learn to use that technology or when we take advantage of that technology; especially when we are dealing with patients. (IN1)

Data security is emphasised by the need to enhance one's awareness in maintaining data security, avoiding misuse, following regulations and laws related to data security and avoiding the risk of data leakage by using data protection.

> For example, in the use of an integrated referral information system between healthcare and hospitals, there is an exchange of data that is quite detailed and specific, we have to be really careful. (T, D5)

### *Intellectual, analytical and creative ("doing the thing right")*

Biomedical and clinical sciences are needed in the proper use of medical ICT, including the use of telemedicine, eMRs and information systems in hospitals.

> How [can we] generate information systems in hospitals? We can't just rely on the IT team working, but there must also be doctors who really understand clinical matters. (D, D4)

In evidence-based practice, doctors must master the use of relevant technologies, such as AI, to seek sources of evidence-based medicine.

> The source we asked, ChatGPT, had to be criticised again to find out what was right. Because indeed, sometimes it will create sources composed by GPT itself...the ability to be evidence-based makes me more careful about trusting the technology, especially AI. (T, D10)

"Data management" refers to the ability to process data and use them effectively for patient care, decision-making, planning and research.

> A researcher and a clinician must understand the process so that the data obtained are not trash, but good data. Capabilities related to data, storage and processing are essential. (IN2)

### *Personal and professional ("the right person doing it")*

The personal and professional aspects indicate the role of a doctor as a professional with personal intelligence. In this case, personal and professional competencies encompass the domains of ethics, patient confidentiality and lifelong learning.

> It seems that, aside from doctors, many professions will be replaced by ChatGPT, which is quite terrifying. In the end, what will make the difference is ethics. (S, D5)

Policymakers must also consider the regulation of professional ethics in the use of medical ICT to prevent doctors from committing violations and to help them avoid legal claims and litigation.

> We must assess whether it is ethical (during telemedicine) to provide advice to patients without a physical examination. Is it ethical to prescribe medications, for example, through some pharmacy software that allows a patient to get drugs like midazolam or diazepam just by asking their symptoms and then immediately issuing a prescription? (S, D1)

The regulation of professional ethics must consider doctors' use of medical records, telemedicine, social media, the need to maintain patient confidentiality and the potential misuse of data.

> Nowadays, everything can suddenly go viral, so we have to remind our students that they should be taught about certain limitations, especially if they are healthcare professionals. There is a professional oath that must be obeyed on how to protect patient confidentiality. (T, D8)

Lifelong learning is associated with the abilities to adapt to technology in this 4.0 era and undergo continuing professional development programmes. This realm is part of a doctor's competence as a professional with personal intelligence.

> Lifelong learning and technology go hand-in-hand; they will always evolve. If we don't update and keep up with the latest technology or knowledge, we will surely fall behind our peers. (S, D10)

The themes and subthemes were relevant to the need of ICT competencies of medical graduates in Indonesia. As highlighted by the policymakers, as follows:

> In our era, we are encountering various technological advancements from all directions. How can we possibly incorporate them if we are not familiar with ICT? Therefore, these competencies are intrinsic to a doctor and must be cultivated. (IN4)

> Preparing Indonesian doctors to adapt to ICT is crucial, but as humans, they must also address ethical issues. (IN3)

## DISCUSSION

This study revealed three emergent themes regarding ICT literacy among medical graduates, which highlight the use of ICT in healthcare and health education, the challenges involved in the use of ICT and the required health-related ICT competencies among medical graduates. Healthcare and health management, chat applications, eMRs, medical calculators, AI, telemedicine applications, video conferencing, social media and professional applications are widely used today. In particular, the use of eMRs is crucial because it can reduce fragmented data, enhance continuous healthcare information exchange amongst healthcare professionals and improve patient safety (22). The system has been incorporated in Indonesian healthcare system which further highlights the need of medical doctors' competencies in this area, including in effectively utilising eMRs.

At the same time, doctors must understand the limitations of remote consultations through telemedicine. Medical calculators, eMRs and telemedicine could be incorporated into an integrated hospital system, which is an ICT-based system that processes and integrates the entire flow of hospital services in the form of a coordinated network, thus improving the precision and accuracy of reporting and administrative procedures (23). A doctor should also be capable of analysing and assessing the validity of the technology being used, including AI. Such a technology should only serve as an assisting tool in diagnosis confirmation, rather than serve as a primary means of establishing a diagnosis. Meanwhile, in terms of using social media for socialisation and promotion, a doctor should understand and adhere to the limitations set forth by the principles of medical ethics.

Similarly, the use of technology is also relevant in medical education which mostly serves as a medium that can help improve students' knowledge. As a good educator, a doctor should be able to foster a supportive learning environment by using technology that enhances the learning process (technology-enhanced learning), such as through using learning videos, AI-based applications and VR. In particular, the learning model using video simulation media is one of the applications of social learning theory. The use of video media, along with note-taking, design and flashcard applications, can help manage and reduce cognitive load in one's short-term memory (24). Delivering essential information in a structured format and using visual aids can reduce cognitive load and facilitate the processing and understanding of information (25). When conducting education through social media, a doctor is required to provide valid education and counter false information whilst prioritising ethical principles. Furthermore, a doctor must possess the ability to process data and choose appropriate data processing applications. Given that AI is considered a relatively new technology, its validity is still being questioned. Thus, the principles of evidence-based medicine should always be applied when using any kind of related technology (26).

This notion on the use of technology is aligned with the technical competence identified in this study. As explained previously, "technical competence" refers to one's ability to analyse the technology needed and operate such technology in services, education and research based on patients' needs. These include the abilities to perform analysis in medical informatics and its relation to various roles in medical practice; integrate conventional clinical skills with the use of digital technologies that support patient care or optimise service delivery, such as medical calculators, pathology software, telemedicine, eMRs or technologies that help develop treatment plans; use and operate technology-enhanced learning; identify the purpose and benefits of clinical information systems and operate government-owned information systems and applications to support routine clinical services; and identify the benefits and learning practices of using AR and VR, the basics of AI algorithms in supporting clinical decisions and other programming languages (4, 11, 27).

The challenges involved in promoting the use of technology are divided into infrastructure constraints and challenges related to human resources. These are highlighted in this study. The development of the region's infrastructure is closely related to the government's policies. For example, establishing and maintaining ICT facilities as infrastructure can drive the implementation of such technologies. Meanwhile, the challenges in using technology, as reported by the informants in this study, are related to several aspects, including human resources constraints (e.g., ethical violations and disparities in technology literacy and utilisation). This should inform the policy of using ICT in healthcare and medical education in Indonesia.

There are still groups of the so-called late majority and laggards amongst doctors from different age groups or generations. In the current study, senior doctors tend to be considered more resistant to learning technology. However, there was no difference in confidence between younger and older learners when it comes to learning technology, especially technology that is beneficial for daily activities. Furthermore, although older age represents longer exposure to technology, the quantity of technology they are interested in learning may be lower (28). In contrast, younger individuals tend to use a wider range of technologies. For example, Hauk et al. (29) suggested that age is only related to the perception of ease of use, particularly for specific technologies. In addition, it has been shown that the ability to use technology is closely related to a positive attitude and self-efficacy (30).

Both personal and professional aspects prioritise ethics in using technology. Cases of data misuse and ethical violations by doctors in using social media are still encountered. For example, as shared by the FGD participants, a doctor was found uploading information about surgical procedures on Facebook without maintaining patient confidentiality. Posting discussions about patient cases in open media and even turning them into jokes, were also observed. These actions directly violate the principles of doing good (beneficence), not causing harm (nonmaleficence), respecting patient autonomy (autonomy), and acting in a just manner (justice) (31).

Furthermore, intellectual, analytical and creative competencies are also highly relevant in ensuring ICT literacy, as underlined in this study. These include the ability to analyse telemedicine consultation specifications, assess important symptoms of a disease when patients consult remotely with doctors, appropriate consultations with patients and medication management or e-prescriptions. Whilst online pharmacy services make it easier for patients to obtain the therapy they need, doctors must understand the limits of consulting services as well as medication management and prescriptions when conducting

telemedicine (20). Medical graduates must also implement clinical and biomedical science in conducting technology-based research, administering management information systems and identifying clinical decision support systems based on evidence-based analysis. They must also perform data analysis using appropriate tools to improve services, assist in planning, making decisions, conducting research and presenting quality data in an informative manner.

Finally, personal and professional competencies in using ICT were also identified in this study. This competency includes the abilities to integrate medical ethics in the use of technology; apply ethics; identify laws and regulations regarding the use of eMRs, telemedicine and social media; and avoid misuse of data (11, 20, 32). These could be widely disseminated through continuing medical education and even earlier through the availability of a relevant medical ICT curriculum. The use of technology that is increasingly advanced and assists in clinical decision-making should not reduce professionalism and collaboration ethics, amongst colleagues and fellow professionals (11, 12). To maintain patient confidentiality, medical graduates must protect personal and health data and be aware of areas of privacy in educating the public through open information media when using telemedicine and performing scientific presentations (20).

Lifelong learning directly influences medical doctors' professional behaviour. Thus, medical graduates must possess the ability to adapt to medical ICT, including identifying technologies that are beneficial to patients' interests and assessing online literature sources as part of their continuing medical education and lifelong learning efforts (12, 18, 33). The use of technology is based on the principles of ensuring patient-centred treatment and patient safety, as well as increasing interprofessional collaborations (12, 22). Indeed, technologies that do not benefit patients should not be taught (15). Effective communication can be achieved when doctors build good relationships or rapport with patients when operating or using technological media, such as eMR and telemedicine (20). Furthermore, doctors can communicate well when they strengthen their ability to use ICT in the form of video conferences (webinars) and social media in the context of educating the public and correcting inaccurate health information (12, 20). When dealing with technology, doctors might be busy filling out eMRs and not give their full attention to patients, potentially causing depersonalisation. To avoid this, they must develop their relationship-building skills with patients and their families. The culture in Southeast Asian countries dictates that a patient's family plays a large role in making decisions related to the patient's health. Thus, effective communication not only applies to the doctor–patient relationship but also to the relationship between the doctor and the patient's family (15).

This competency also highlights the importance of data security and its corresponding awareness. The potential for data leakage begins when a doctor grants access, such as sharing usernames and passwords with others. Data leakage can also occur when using technologies such as eMRs and health information system (HIS). The abilities to identify regulations and laws regarding data security and its misuse, analyse potential data leaks, and anticipate them to protect data are therefore critical (11, 20, 32). Such abilities should also be supported by lifelong learning skills, which potentially lead to medical ICT advancement.

The current study identified competencies related to ICT in healthcare and health education. Its findings have two main implications. First, the formulated core competencies can be integrated into the existing curriculum more systematically through a competency-based approach. This is highly relevant for all medical schools in Indonesia, as well as Southeast Asia. Such an approach aims to equip future graduates, who will become doctors and health professionals, with the necessary ICT abilities as a central part of the curriculum. It is a

foundational step to formulate competency milestones at each stage and define relevant educational strategies, teaching methods, learning experiences and their assessments. A comprehensive evaluation is then carried out to assess the effectiveness and efficiency of the programme (11). The implementation of ICT curricula for institutions requires strategies based on the following goals: to provide infrastructure, such as computer or biomedical laboratories equipped with advanced technology, as well as technology learning resources that are easily accessible to students; to allocate time and resources for the development of faculty in the field of medical ICT; and to initiate continuing medical education programmes with materials and skills related to medical ICT (34).

Second, the curriculum that has been designed, along with the relevant strategies, can be implemented with the support of policymakers to ensure the availability of resources, such as adequate learning environments. Conducive learning environments are supported by infrastructure, human resources and teaching staff; interactions amongst teaching staff or between teaching staff and students; teaching and assessment methods; and other factors. This study also recommends paying more attention to the necessary faculty development, which can ultimately be considered a model for developing countries. The ICT-related competencies should first be supported by institutional policies, leadership, availability of medical education and ICT experts in institutions and various supportive systems. The development of teachers' capacity, as well as the recognition of students' characteristics, may further encourage curriculum implementation in this area (34, 35).

The authors are aware of this study's limitations. This study was conducted in just one country; hence, the results are highly contextual. Nevertheless, it offers saturation of the variation of data from informants with diverse backgrounds. Thus, it is expected that this study can provide an overview of the ICT literacy competencies required by medical graduates, which are relevant for Indonesia and other settings.

## CONCLUSION

This qualitative descriptive study identified three interrelated themes on the use of ICT in healthcare and health education, the challenges involved in the use of ICT and the competencies of health ICT needed by medical graduates. The ICT-related competencies are indeed critical in the current era of modernised healthcare and health education. Thus, the present study highlights ICT competencies in a comprehensive manner from the technical, analytical–conceptual and personal–professional aspects. In turn, these further inform the curriculum development and necessary system and faculty development in medical schools.

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## ETHICAL APPROVAL

The current study was approved by the Ethics Committee of Universitas Indonesia (protocol number: 23-04-0509).

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