Research

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Bridging the gap: Competency-driven health informatics education for future healthcare leaders: a PhD study

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Information and communications technologies are becoming integral to modern healthcare, advancing the adoption of health informatics and transforming the competencies required of healthcare professionals. This digital shift necessitates a re-examination of healthcare education to ensure alignment with evolving practice demands. This study explores healthcare professionals' perceptions of health informatics education and its contribution to developing digital competencies. Thirty-one participants were recruited through purposive and snowball sampling strategies, representing eight healthcare disciplines: medicine, nursing, social work, occupational therapy, physiotherapy, dietetics, pharmacy and dentistry. Data were collected through semi-structured interviews and analysed using thematic analysis. Participants identified emerging aspects of digitisation within healthcare, such as digital health-record systems, artificial intelligence and open-source applications, that require enhanced digital skills training. However, limited attention to health informatics within undergraduate education and insufficient workplace training were reported as key barriers to digital competency development. Despite these limitations, participants expressed a strong interest in digital innovation, particularly following their experiences during the COVID-19 pandemic. This presents a strategic opportunity to strengthen health informatics education. The study concludes that integrating health informatics competencies through updated curricula, blended learning methods, and targeted professional development is essential for preparing healthcare professionals to effectively engage with digital transformation in healthcare. Furthermore, by default of being born in a highly digital transformation era, this generation of healthcare professionals is strategically placed to drive healthcare digitisation and future innovations.

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The progressions of information and communications technologies (ICTs) in healthcare have led to the increased use of devices for personal health monitoring during exercise activities and rest, clinical technologies that enable teleconsultations, health information management and communications, and health data manipulation for improved healthcare.[1] These technologies and their applications are part of health informatics (HI), which can be explained as a subfield of the information systems discipline that is at the juncture of computer science, social science, behavioural science, information technology and healthcare or medical care practices. These discipline domains are applied in an interdisciplinary approach for information processing and problem-solving activities in the healthcare sector.[2] Other definitions suggest that HI is a discipline concerned with the management and manipulation of health data and information through computing technologies.[3]

Advances in computing technologies have reshaped the scope of competencies across most professions, leading to the disappearance of certain occupations[4] and the emergence of entirely new career paths.[5] These developments have particularly affected professions that originated during the industrialisation era, many of which have been replaced by information- and knowledge-based occupations.[6] Consequently, digital competencies have become indispensable skills that everyone must possess, as they are integral to functioning within a technology-driven civilisation.[7] Competencies can be described as abilities or know-how developed through learning and experience that enable one to accomplish specific tasks.[8] The evolving demands of future occupations require educational institutions to adapt their programmes to equip graduates with relevant and contemporary competencies.[5] In South Africa (SA), the training of healthcare professionals is primarily undertaken through institutions of higher learning.[9] Therefore, the introduction and development of HI competencies are most effectively implemented at the undergraduate level, where core professional skills for practice are established.[10] Health professions education (HPE) has become a central focus of the global health agenda as part of efforts to strengthen healthcare systems. Accordingly, training curricula should integrate essential competencies that leverage ICT as a foundation for the continuing improvement of healthcare delivery.[11] ICT-related competencies should thus be regarded as a fundamental requirement in healthcare education rather than a secondary component.[10] Furthermore, healthcare education is increasingly shifting toward digital platforms, with greater use of technologies such as digital clinical simulations and online learning, thereby augmenting the need for digital competence.[12] However, this does not imply that healthcare professionals must become ICT specialists; rather, they should be proficient and knowledgeable users of digital systems.[13]

Alanazi's study[14] recommends a comprehensive 15-week HI course with an interprofessional focus designed for healthcare professionals. The proposed course covers key topics, including fundamentals of HI, applications of health information systems, data analytics and business

intelligence in healthcare, leadership and management in HI, and an HI-related project.[14] The strength of this course lies in its integration of HI fundamentals through an interprofessional education (IPE) approach, accommodating a diverse range of healthcare professionals. As emphasised by the International Medical Informatics Association (IMIA), the level of HI competencies required varies according to hierarchical structures within healthcare professions and is influenced by factors such as responsibility, academic qualifications, career orientation, and professional role.[15] Accordingly, the content proposed by Alanazi[4] may be sufficient for general users, while more advanced competencies could be reserved for specialised roles.

HI applications in healthcare are inevitable,[14] but they come with challenges because the HI discipline is constantly evolving owing to its vast correlation to multiple disciplines' domains, geographic and socioeconomic environmental contexts, and the subjectivity of stakeholders. Furthermore, HI is complicated by the lack of a distinct blueprint to follow, which requires extensive applicable research, models, and guidelines to be developed for a fundamental reference point.[16] This dynamism requires constant management, which requires leadership qualities, including change, innovation, technology, and strategic orientations, in addition to inherent leadership qualities and skills.[17] Therefore, this research aims to explore healthcare professionals' perceptions of HI education towards developing HI competencies. The findings of this research will assist in addressing the challenges of healthcare professionals' HI competencies to improve technology acceptance in the midst of ongoing digitisation.

Method

This research was conducted through a descriptive qualitative approach[18] to gather participants' insights regarding their experiences in HI education toward the development of competencies. The research's presentation was guided by the consolidated criteria for reporting qualitative research (COREQ).[19] The participants were selected through purposive sampling and snowballing strategies.[20] The participants were recruited through email and referral correspondence based on their professional affiliations. The strategy enabled the inclusion of participants who were knowledgeable about their professional occupation and could provide in-depth insight into the phenomenon under research.[21] The research sample was made up of 31 participants, comprising 14 lecturers, 6 final-year students at a university and 11 professionals from a healthcare facility in the Western Cape Province of SA. The study participants were from eight healthcare professional disciplines: medicine, nursing, dietetics, physiotherapy, occupational therapy, dentistry, pharmacy and social work. The participants' constitution is illustrated in Supplementary Table 1.

Data collection

Data collection was conducted by the primary researcher, a male doctoral student with a master's equivalent degree. Individual semi-structured interviews ranging from 10 to 40 minutes were conducted in person or online, in English. All interviews were audio-recorded with the participants' consent. Two pilot interviews were conducted to pre-test the interview schedule's feasibility and suitability. Individual in-person interviews were conducted at the university and hospital premises. The interviewer and participants had no prior relationship except what was communicated through the information sheet regarding the researcher's intention. The research attempted to achieve saturation. The interview guide is available as Appendix A.

Table 1. Regulatory recommendations

Disciplines	Regulatory HI recommendations
Medicine	Participants were uncertain of any recommendations. They highlighted that it was challenging to correspond with the body. (Medicine_Professional1 and Medicine_Professional2)
Dentistry	Some participants highlighted that they were aware of digitisation and computer literacy recommendations, but they were uncertain about the specific details. (Dentistry_Lecturer and Dentistry_Professional1)
Nursing	All participants believed there were no digitisation competencies recommendations from their professional body.
Physiotherapy	The lecturing participants noted that there are conversations around digitisation literacy and telerehabilitation, but there are no clear recommendations except for computer literacy. The student was not exactly sure about the recommendations but believes there is something. (Physio_lecturer1 and 2)
Occupational therapy	The lecturers and student participants noted limited recommendations with computer literacy as the bare minimum graduate requirement. The professional was not aware of any recommendations. (OT_Student, OT_Lecturer1 and 2)
Dietetics	One of the lecturing participants noted computer literacy and online consultations as the recommendations that have come to their attention. (Dietetics_Lecturer2)
Pharmacy	The participants noted that e-prescriptions and electronic consultations (telehealth) were recommendations that came to their mind, and only one participant was uncertain. (Pharmacy_Lecturer1, 2 and 3)
Social work	The lecturers and students acknowledged that their professional body has made recommendations for telehealth and the use of technology applications in social work and continuing development programmes. The recommendations were prevalent at the peak of the COVID-19 pandemic. However, some participants highlighted that the recommendations were insufficient to provide conclusive guidelines. The practising professional participant was uncertain. (SW_Student1, SW_Lecturer1 and 2 and SW_Professional)

Data analysis

The audio recordings were transcribed through three different processes by the researcher (n=3), an independent transcriber (n=15), and the

digital platform Riverside (n=13). This aided in improving the accuracy and objectivity of the transcriptions.[22] The data were analysed using the six-step thematic analysis method to synthesise the findings.[23] Step one required thorough familiarisation with the data.[24] The researcher conducted all 31 interviews in the study, transcribed and read through all the transcriptions, and cleaned up the transcription data. Step two was the data coding stage, conducted through an online application known as Taguette, a qualitative data analysis application that aids in data coding and management. Coding was conducted by two researchers. The two independently coded data sets were compared and reviewed for intercoder reliability (ICR).[25] Step three of the process was theme identification.[24] The codes were rearranged into related themes to gather constructive meaning. Four themes were identified from the research data. In step four, the themes were reviewed for meaning and coherence for logical data reporting.[24] The codes were written up and reallocated to different themes where necessary for a coherent results report. Then, in step five, themes were analysed and discussed.[24] The themes was analysed, renamed, and rearranged for a coherent final report. Lastly, step six was the report compilation.[24] The discussion is part of the report that describes the results in conjunction with empirical literature to deliberate on the research findings.

Trustworthiness

The rigour of qualitative research is considerably elusive, given that qualitative methods are not rigid, but without rigour qualitative studies lose their scientific credibility.[26] The researchers attempted to achieve rigour by exercising some reliability and validity factors across the research.[27] An environmental triangulation strategy was considered, with participants drawn from a tertiary education and healthcare facility comprising multiple healthcare professions disciplines and different departments.[28] An independent transcriber transcribed 48% of the recordings, and the coding process was conducted by two researchers.[26] The coders reported an 87.5% ICR.[25] During the research, because of awareness of possible bias, member checking was done to ascertain that the results and discussion were not distorted.[29] The researcher compiled the research steps undertaken to provide context for potential reviewers.[27]

Ethical considerations

The research was ethically cleared by the University of the Western Cape's Biomedical Research Ethics Committee, and granted permission by the gatekeeper, Western Cape Department of Health, Tygerberg Hospital Research Projects (ref. no. BM21/4/9). The participants were issued information sheets to advise them about the study and their rights. They were required to sign a consent form to confirm their willingness to participate in the study. To protect the participants' anonymity, they were allocated pseudonyms denoting their professional discipline and occupation only.[30]

Results

This study explored healthcare professionals' perceptions of HI education toward developing HI competencies. This was conducted in an attempt to understand what HI content is required in HPE for HI competencies. In this regard, the results section describes the participants' knowledge of HI systems, required competencies, and the training and education needed to attain the necessary competencies. The research identified four main themes: HI applications; HI-required competencies; healthcare regulatory requirements; and training, teaching and learning practices. Two subthemes were identified: opportunities and weaknesses; and training, teaching and learning.

Theme 1. HI applications

The HI applications theme explores technological applications that participants can identify as relevant to their respective professions. The HI applications in this instance refer to digital systems or technology platforms used to accomplish tasks. The participants discussed multiple processes that have been digitised and where they apply digital skills on their own initiative. They noted the increased use of computers for patient records and personal devices, such as mobile devices, for ease of communication. The electronic record systems for patients' records were the most prominent across all disciplines. The participants could tell that there were different systems, which they could access and others they could not, but they were not aware of the technical differences, whether they were patient, health, or medical electronic record systems, which could be different altogether. A significant number of healthcare professionals in practice were aware of the systems and could describe their use as follows:

> *So there's now a new system, online system, where I'm not sure what the name is, where the patient comes in, and you start the consultation, and then you can see the times the patient has been in, so I think that is now being new and you can see the pack and the things that you treat the patients with.* (Nursing_Student1)

There were also instances where the participants used social media and free digital technologies besides the institution-provided systems for professional communication and information-sharing purposes. The practising participants noted creative use of social media and Google applications, including WhatsApp and Google Drive, in communication and information sharing: … *between ourselves, we have like a Google Drive or share drive, share point and we share information on that platform so that there's continuity of care for patients.* (Dietetics_Professional)

Lecturers and students also use social media and Google Workspace. However, the legacy systems are still common, especially in administration-related processes, such as telephones and emails.

Participants noted that some medical directories and information books have been digitised. The internet and mobile applications (apps) are replacing books, creating convenient and easily accessible platforms to look up information, such as the pharmacy *SAMF* (*South African Medicines Formulary*) and Micromedex for medicine catalogues (Pharmacy_Lecturer3). It is important to note that the *SAMF* is designed for use by all healthcare professionals to research medical drug information. The COVID-19 pandemic led to innovative approaches to accessing medical professionals, with the VULA app being mentioned as a medical digital directory (Dentistry_Lecturer1). Internet-based systems for consultation and interventions, including telehealth and telerehabilitation, were mentioned. Some disciplines, such as dentistry and occupational therapy, also use 3D applications to model and develop prototypes for interventions. Supplementary Table 2 provides a summary of applications and systems as identified by professional groups.

The findings highlight the prevalence of digital health records across all professional disciplines regarding patient information and computer office applications for administrative purposes.

Table 2. HI challenges in healthcare

Weaknesses	Participants' perceptions
There are limited HI skills	Some of the participants felt there were not enough skills in the education and training space. Some of the lecturers were adamant that their disciplines were totally lacking in HI competencies education. *Sometimes you get, like when we're doing primary healthcare, then the one professor talks about all of it, but I think we should get more people that is skilled in that one subject.* (Nursing_Student1)
There is a limited digital skill focus in the curriculum	There was an acknowledgement that the curriculum is lacking in HI content. *If I think of what we do when we teach, we don't teach our students any of that. We have something called practice management, but I know that our students actually don't look at those systems at all, so yeah.* (Dentistry_Lecturer1)
Decisions on HI guidelines, or lack thereof, still need discussion	Some participants thought that the lack of guidelines was a major issue, and the unequal distribution of resources was a major hindrance to HI competencies development at the training or education level. *Reason being is they cannot … they can set guidelines, but each institution works within the limits of their resources, so they cannot make that kind of demand about what you must use and the tools you have to use.* (Dietetics_Lecturer1)
Perceptions on the relevance of digital platforms	HI is still viewed with scepticism. *I mean, it's not that use of particular technologies are detrimental to the safe practice of dietetics care. So, I don't think that they will ever be in a position to make those kinds of recommendations.* (Dietetics_Lecturer1)
Digitisation or HI is not yet a compulsory learning outcome in healthcare education programmes	The inclusion of the HI curriculum in healthcare programmes is not yet compulsory. *There are conversations around telerehabilitation and all that, but it's not a requirement for learners to know.* (Physio_Lecturer2)
Limited resources and infrastructure	There are still HI-supporting infrastructure limitations. *Like fibre should be like a basic human need … the world is so technology-infused that that should be part of it, so basic resources and infrastructure should be there, in safe ways for our students.* (OT_Lecturer1)
Students have limited HI or digital-based skills	Though there are expectations that the current crop of students has been raised with technology implementations around them, they seem to lack the application competencies. *I found that even some of the students who are at a third- year or fourth-year level ... We often think that because everything is so on social media, digitised, they are competent enough, maybe above me in MS Excel. And then when they actually have to apply in practice or in the application of healthcare within the digital space, they struggle.* (Dietetics_Lecturer2)

Theme 2. HI-required competencies

The HI competencies theme discusses the participants' perceptions of abilities and skills required to practise in HI-infused healthcare environments, i.e. a set of skills required to be able to use computing technology. The participants discussed various applications they use in their professional spaces, some in an innovative way and others as intended (noted in Supplementary Table 2). Important competencies have become essential across all health professions disciplines. Almost all participants acknowledged the need for basic computer skills and application software for administrative purposes, as noted by most participants from the nursing, social work and occupational therapy professions. Competencies in digital health information systems seem to be of high importance because they apply to most professions, including less clinical professions such as social work:

> *We have a clinical system at the hospital. If we need information about a patient, we need to go onto the clinic system, and we can find additional information there.* (SW_Professional)

Some disciplines are already gravitating toward digital platforms for safer and less invasive measures to interventions and treatment strategies. Academic institutions are looking into 3D, artificial intelligence and virtual reality (AI & VR) for prototypes and simulations:

> *We're going to see the research projects coming down into the university, so like I say like things around AI and virtual reality and 3D printing are the three that are in my head at the moment. I think we're going to see more of that coming in, and I'm excited to see how that then influences teaching.* (OT_Lecturer2)

Therefore, proactive strategies to develop interest and competencies in emerging will be important for developing sound competencies for professional practice. However, the participants noted that some applications are subject to the field of practice. A summary of the competencies is listed in Supplementary Table 3.

Theme 3. Healthcare regulatory recommendations

Since healthcare disciplines, practices and education are regulated, it is essential to understand the regulatory requirements and recommendations. This theme explores participants' familiarity with their regulatory bodies' recommendations regarding HI. Most participants were uncertain about their regulatory bodies' stipulations regarding HI and digitisation in their respective disciplines. This uncertainty stems from the limited focus on HI guidelines. However, there were a few participants who highlighted some recommendations from their regulatory bodies, mainly lecturers and students who possessed some digitisation skills. Table 1 summarises the participants' familiarity with their regulatory bodies' HI recommendations.

The perceptions are not conclusive of the professional bodies' recommendations, but rather the participants' views and familiarity with their regulatory authorities' approach to HI. These perceptions highlight different considerations of respective regulatory authorities for HI across different professional disciplines, with some still lagging and others a bit more advanced.

Theme 4. Training, teaching, and learning practices

Health professionals' HI competencies are developed through relevant training, teaching and learning practices for current and future practice. This

Table 3. Opportunities for HI

Opportunities	Suggestions
Develop curriculum according to practice standards	The participants noted the need for an HI curriculum to develop competencies for practice. *I think it's very important that when institutions of higher learning think of integrating computer skills... It's very key that they firstly understand what kind of system is being used in the real world.* (OT_Lecturer1)
Develop national benchmarking standards	The participants believe there is a need for compulsory guidelines for healthcare educational programmes. *So there needs to be a standard across the board. So, I think it's a little bit bigger than the institution because the national health system should move in that way.* (Physio_Lecturer2)
Introduce the HI frameworks for guidance in curriculum development	Some participants suggested the development of curriculum frameworks inclusive of HI content. *But I think there needs to be a framework. It needs to be built into your curriculum.* (Pharmacy_Lecturer1)
Educate the educator	There was an acknowledgement of inadequate HI- or digitisation-competent educators among healthcare professionals' educators, as noted: *…and you need to educate the educators as well, and maybe something like the trainer would be helpful.* (Pharmacy_Lecturer1)
Teaching and training in applicable technologies	They suggested applicable HI skills besides basic computer training for students. *So, students are born with technology; however, that's not saying that they know how to use it, so just because you know how to use a phone and type on a keyboard doesn't mean you know how to use VR or the good uses of AI.* (Physio_Lecturer2)

section describes opportunities and weaknesses in academic and practice training, and teaching practices and possible curriculum components that will enable the development of appropriate competencies.

Subtheme A. Opportunities and weaknesses

In this context, weaknesses refer to negative factors that present disadvantages, while opportunities denote factors that may have a positive impact. Identifying weaknesses and opportunities facilitates a deeper understanding of the role of education in addressing gaps in digital competency. Most participants reported feeling inadequately prepared to fully comprehend digitisation within their respective disciplines, whereas a few believed they possessed satisfactory skills. Table 2 presents participants' perceptions of the weaknesses or challenges that need to be addressed to enhance HI competencies and promote effective digitisation in healthcare. The table highlights that digitisation in healthcare has not yet been fully embraced owing to various reasons, including its limited consideration in the education of healthcare professions, limited digital infrastructure and regulations that enforce it as a required competence.

All participants were asked to make recommendations to improve HI competencies. The professionals in practice were mostly uncertain, but lecturers and students had various suggestions to help improve the integration of HI into academic healthcare programmes. The most notable opportunities that can be explored in academic teaching and training are outlined in Table 3. The key perceptions underscore the importance of aligning curricula with practical healthcare demands, empowering healthcare professionals through specialised HI training, and implementing applicable frameworks to standardise HI competencies across the healthcare sector.

Subtheme B. Training, teaching and learning

The development of competencies in healthcare is dependent on training, teaching and learning. This theme discusses the expected curriculum, teaching practices or methods, and expected learning outcomes. The participants were mainly focused on computer and software applications when it came to curriculum content. There was mention of training in practice applications by professionals. The participants noted the HI knowledge gap and the importance of training.

> *…I had never used or come across Zoom, and now Zoom is even part of our day-to-day language. So, yes, you need to have the correct training.* (SW_Lecturer1)

The participants noted that various teaching and training methods could be applied to improve comfort in digitisation and HI-enhanced settings. Computer literacy was highly considered as a priority, as noted:

> *I think computers, they can be part of the level exit outcomes, and it can be considered as part of the curricula instead of saying that everyone is computer literate, but it should be in.* (OT_Lecturer1)

The students and lecturers mentioned exposure to technology at clinical placements. There were suggestions for elective modules and short courses outside the curriculum to improve competencies in some HI applications.

The participants acknowledged that the use of digital applications in teaching and learning can be useful in developing skills for practice. One lecturer highlighted the practical use of digital applications in education settings:

> *We have open-book exams so they can use that. They can also use, for example, our standard treatment guidelines, which are available on the Knowledge Hub, so they can access that.* (Pharmacy_Lecturer1)

The nursing and occupational therapy lecturers acknowledged that simulation platforms and HI exposure at clinical placements can form part of the practical learning experience, though there was emphasis on human engagement as well.

Some participants noted that the use of learning management systems (LMS) can improve students' comfort with technology use. However, a number of participants were uncertain about the LMS's impact owing to its inconsistent use, as noted:

> *So I think if they are forced to use the LMS, you definitely become a lot more familiar with the technology and, you know, there are skills that you learn that you can carry over elsewhere.* (Dentistry_Lecturer)

There were views that LMS and other administration systems were reasonable platforms for improving lecturers' and students' technological comfort. Based on the findings of this research, Supplementary Table 4 highlights a summary of the guidelines for the curriculum.

The findings of this research highlight that most of the healthcare lecturers were also limited in HI knowledge, therefore necessitating interdisciplinary collaborations, considering that computing technologies are from the sciences and business disciplines. The applicable teaching practices include blended teaching practices that include technology use and in-person engagements for HI-ready healthcare professionals.

Discussion

This research explores healthcare professionals' perceptions of HI education toward developing HI competencies. This research was conducted to understand the healthcare professionals' perceptions of HPE for HI competencies. The growing use of technology in healthcare has diversified healthcare professionals' competencies requirements, adding the need for digital and data-work skills. These changes necessitate restructuring the HPE curricula to meet the modern-day healthcare professionals' competency demands.[31]

The participants noted that the public healthcare institutions have started integrating digital technologies. This highlights the change in healthcare professions, which are becoming knowledge occupations that practise in resource-constrained environments but with growing demand for quality and effective healthcare.[32] The participants in this study showed a keen interest in using digitised technologies. In addition to the workplace platforms, they acknowledged the use of online applications and personal devices for convenience in healthcare practices. However, it was concerning that most participants were not well versed in the HI or digital terminologies, except for basic computer knowledge acquired through training and computer literacy courses. This concurs with research that computer literacy is not adequate for HI competencies.[33]

The findings from this research show that healthcare professionals' curricula are lacking in fundamental HI content, which is observed in Cummings *et al*.,[10] who notes a lack of streamlined HI curricula for healthcare professions. Some of the lecturers acknowledged the inadequacy of computer literacy in the healthcare curricula and suggested the need for more digital skills for HI in healthcare. The considered digital health content includes information and record management systems, cybersecurity, data protection and security, ethics in digital health, and using technology for decision support. This concurs with research by Mannevaara *et al*.,[34] which highlights most of these considerations and business concepts to improve healthcare cost comprehension and innovations. As it is, the curricula and guidance from regulators are lagging behind the pace of technological innovations and advancements. Some of the current research in digital health in healthcare is extending into nanotechnologies, which are expected to impact all healthcare professions' practices, including patient care and monitoring, drug development and administering, rehabilitation methods, surgeries and research that advances healthcare practices.[35] This denotes a big variance in healthcare professionals' current capabilities, which are still grappling with basic digital competency and impending technology advancement, which are treading on the verge of advanced digital technologies.

The participants acknowledged that changes in healthcare require that digital skills and computer literacy become part of graduate outcomes. Therefore, applicable teaching and learning practices should be considered. There was a recommendation for more dynamic teaching and learning approaches. The lecturers also discussed the inclusion of AI applications in learning and teaching. Dynamic teaching and training practices are required for contextual competencies that are infused into the professional disciplines.[31] The training should consider that HI applications, integration, and competencies development are a multidisciplinary undertakings that require contributions from multiple disciplines, including science, business, and health.[16]

Most of the participants were not familiar with their regulatory bodies' stance on HI, and some stated that their guidelines lacked in that regard. The integration of HI into healthcare denotes the significance of leadership, which has become increasingly important with the rapid advancement of technology and the growing complexity of healthcare practices. Effective leadership among policymakers is essential for providing strategic direction on technological innovation and for the development of competencies that support the efficiency and adaptability of healthcare professionals. The guidelines and strategies regarding HI need to be articulated for the understanding of the HPE multiple stakeholders' dynamics.[14] This requires comprehension of the subject matter by policymakers to make informed and applicable decisions to manage technology integrations in the healthcare sector.[36]

The findings of this study indicate an increasing recognition of HI within healthcare, driven by the prevalence of digitisation of most aspects of human activities. The current generation of healthcare professionals is positioned at the centre of digitisation transformation, and their attitudes and behaviours will play a critical role in determining the extent to which HI influences healthcare delivery. Consequently, these professionals must assume leadership roles in navigating and guiding the profound digital changes shaping the healthcare sector. Hence, the relevance of appropriate competencies, including transformative leadership, will be critical for establishing digital applications in healthcare.[17]

Limitations

The research aimed for diverse participation but was geographically restricted to sampling participants from a single university and a single healthcare facility. While this posed an institutional limitation, the potential for bias was strategically addressed by the composition of the sample. The lecturers were seasoned professionals with years of practice and had diverse academic backgrounds, having graduated from institutions other than their current employer. The students had compulsory exposure to varied clinical environments through placements, broadening their perspectives beyond the affiliated facility. Healthcare professionals at the institute also represented graduates from diverse educational backgrounds. Therefore, the insights collected were not institution-specific, allowing the study to reflect a broader view of HI consideration in SA healthcare education.

Recommendations

Given that the future of healthcare is inextricably linked to digital technologies,[37] it is critical to address the current lag in healthcare professionals' competencies. HI is a developing domain requiring co-ordinated efforts. For the healthcare sector to meet rapid technological advancements, this research suggests consideration of the establishment of HI core competencies for healthcare professionals and the development of supportive systems. The healthcare professions curriculum must be restructured to embed HI as a core competence. The processes should consider collaborative, multidisciplinary, and interprofessional engagements to build comprehensive policies, guidelines, and frameworks.[16] These approaches must clearly define expected HI learning outcomes for all

graduates. Committing to a curriculum that develops appropriate HI competencies will not only improve the adoption of emerging digitisation trends[38] but also ensure the clinical workforce is prepared to deliver modern, data-driven healthcare.

Conclusion

This research explores healthcare professionals' perceptions of HI education towards developing HI competencies. The study's findings reveal a limited and basic understanding of HI among the majority of healthcare professionals interviewed. Notably, only a small minority, primarily consisting of lecturers and students identified as 'digitisation enthusiasts', demonstrated a more advanced comprehension of the subject. The limited understanding correlates with reported low use of computing technologies within healthcare facilities, despite the presence of these systems. This confirms a significant gap between the availability of digital tools and the workforce's functional capacity to utilise them effectively. Importantly, the research determined that HI concepts are not well entrenched within the healthcare professions' undergraduate curriculum. This educational deficit is the cause of the limited subject matter understanding among graduates and practitioners. This finding is highly concerning because digitisation is an inevitable and rapidly evolving force in healthcare. The lack of foundational HI competencies among healthcare professionals will impede the effective adoption and utilisation of advanced digital systems, ultimately hindering quality patient care and operational efficiency in the modern health sector.

Data availability statement.

Declaration. This manuscript is our own original work and has not been submitted, in whole or in part, to any other journal for publication purposes.

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