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Assessing digital health knowledge, attitudes and practices among nurses in Naples: a survey study protocol

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ABSTRACT

Introduction Digital competencies are essential for nurses to actively participate in the digitisation of healthcare systems. Therefore, it is important to assess their skill levels to identify strengths and areas for improvement.

Method and analysis This study aims to investigate nurses' knowledge, attitudes, behaviours, subjective norms and behavioural control regarding digital health. A knowledge-attitude-practice model guided the development of a structured questionnaire divided into six sections. A sample of 480 registered nurses of Naples will be involved in the study. After conducting a pretest, an invitation will be publicised through the institutional communication channels of Nurses Provincial Order of Naples. Nurses will respond via a unique link or quick response code sent through a PEC email system (a legally valid email system, which guarantees delivery and receipt). They will have 30 days to complete the survey, scheduled between *May and July 2024.*

Ethics and dissemination No ethics committee approval was required, as the study does not involve minors, direct or indirect physical or physiological harm to participants, or clinical trials. Anonymity will be guaranteed at all data collection and processing levels. The results will be broadly distributed through conference presentations and peer-reviewed publications. The effective use of digital technologies by healthcare professionals can bring significant improvements to healthcare services and help improve the health of individuals and community health. The study's findings will serve as a foundation for developing and implementing educational programmes related to eHealth and telemedicine, promoting the harmonisation of such programmes.

BACKGROUND AND RATIONALE
Why digital health?
The COVID-19 pandemic has a significant impact on care outcomes and has necessitated the adoption of new, previously underutilised remote intervention technologies by healthcare professionals.[1–9] This rapid adaptation has spurred the proliferation of new health technologies, which have become indispensable in healthcare.[10] Promoting and encouraging positive attitudes towards the increasing introduction and adoption of

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study will employ a systematic sampling approach to ensure a representative sample of nurses, aiming to enhance the reliability and generalisability of the findings.
⇒ The survey is based on the knowledge-attitude-practice model, drawing from Bandura's learning theory and innovation diffusion theory, to assess nurses' knowledge, attitudes and practices concerning digital health.
⇒ A validated survey tool, rigorously tested for reliability and validity across various nursing settings, will be used to strengthen the quality of data collected.
⇒ Reliance on self-perceived digital competence may not reflect actual usage.
⇒ Findings may not apply broadly due to the study's specific geographic context.

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technology and innovation are imperative amid these transformative changes. Delving into and comprehending nurses' knowledge, attitudes and behaviours (KAB) pertaining to digital health is crucial. Exploring these aspects is vitally important, as it not only provides insights into nurses' preparedness and engagement with digital technologies but also informs the development and implementation of targeted actions. These actions may include tailored training programmes and educational initiatives aimed at supporting nurses during this technological transition. Given the aforementioned shifts, gaining a comprehensive understanding of nurses' KAB regarding digital health has become paramount.

International literature highlights how digital technologies benefit both practice and nursing education[11–18] by providing innovative pedagogical solutions.[11 12 17–20]

Mobile devices, particularly smartphones and current health applications ('apps'), have enabled nurses to provide remote pain management counselling to adolescent patients with cancer.[21–23] The utilisation

of mobile and web-based apps has also supported self-management and transition in adolescents with chronic diseases.[24] Wearable sensors have been employed to continuously monitor vital signs in real time among patients with terminal cancer and patients with heart failure, irrespective of disease severity and patient age.[25][26] Additionally, telehealth programmes involving nurses providing daily monitoring, coaching and triage to patients with various chronic conditions, such as chronic obstructive pulmonary disease, heart failure and diabetes, have demonstrated effectiveness in reducing emergency department admissions.[27]

Telehealth and web-based technologies are commonly used interventions that have shown promising outcomes, such as alleviating disease-related symptoms, improving medication adherence and reducing rates of rehospitalisation and mortality.[28–30]

Harnessing the power of digital technologies in healthcare: from eHealth to digital health

With the term 'eHealth', the WHO refers to the use of information and communication technologies to enhance health.[31] This includes mobile devices, software, sensors, online platforms and other technologies that improve communication between patients and healthcare providers, increase system efficiency and support disease management and prevention. Digital health expands on eHealth to include a wider array of smart devices and technologies such as the Internet of things, artificial intelligence (AI), big data and robotics[32] thus engaging digital consumers more extensively. Recent advances in AI have shown significant potential in nursing, particularly through AI-driven chatbots.[33–35] These tools simplify patient communication, are effectively used for remote counselling, aid adolescent with special health needs through the transitions of care[36] and support mental health by providing on-demand interaction for conditions such as anxiety and depression.[34] Advanced AI-like ChatGPT shows promise as a virtual assistant for patients and healthcare professionals. Hopkins AM (2023) found that ChatGPT could effectively retrieve and provide cancer-related information, including tumour types, diagnosis and treatments, with responses comparable to Google's featured snippets. This technology not only delivers accurate information but also frames it in a way that reduces anxiety, offering actionable guidance.[37] Robots, too, are poised to enhance social support in healthcare, necessitating further research into their roles.[21][38][39]

Addressing the digital skills gap in the nursing profession

At the global and national levels, several initiatives have been launched to promote the widespread adoption of eHealth. These include the WHO Global Strategy on Digital Health 2020–2025[32] and the European Commission eHealth Action Plan 2012–2020.[40] Italy, likewise, has implemented the National Recovery and Resilience plan (PNRR)[41] committing 48 billion euros to digital

transition. Despite these efforts, over half of Italian citizens (54%) still lack basic digital skills, highlighting the urgent need for enhanced digital literacy and training (European Commission, 2022).[42]

The Digital Economy and Society Index ranks Italy 18th among the 27 EU Member States in digital performance for 2022,[42] indicating significant variability in digitisation levels within healthcare and the use of health information systems across countries.[43–45]

Moreover, in many countries, national policies or strategies have not adequately boosted resources for nursing informatics and skills development. In healthcare sector, the integration of new technologies and digital services has become crucial to nursing practices, making, informatics skills essential for nurses to effectively fulfil their professional role.[46][47] However, there is global concern about healthcare workers' lack of preparedness for digital transformation and the urgent need for enhanced training. Specific worries include the use of online services in patient care and the adequacy of health workers' competence in guiding and supporting patients with these new digital tools.[48] Increased training needs have been identified in areas such as patient registration systems, structured documentation, basic IT skills and the adoption of new digital services in patient care.[49][50]

At the national level, the National Federation of Orders for Nursing Professions (FNOPI) represents the nursing profession in the interest of members and citizens and promoting public interests related to professional practice. It coordinates and promotes the activities of Provincial Nursing Orders (OPI), which regulate and protect the practice at the local level, enhance the nursing profession and support continuing training to improve nursing care quality.[51] The FNOPI is a non-economic, public law organisation acting as a subsidiary body of the state. It was established by Law no. 1049 on 29 October 1954, and is regulated by Legislative Decree no. 233 of 13 September 1946, as amended by Law no. 3 of 11 January 2018, and subsequent Presidential Decree no. 221 of 5 April 1950. Following the publication of a consensus document by the FNOPI,[52] which outlines future directions for the nursing profession, the importance of acquiring digital skills was highlighted as essential for active participation in the digitalisation of the health system.

Assessing digital skills in nursing is crucial to identify strengths and areas for improvement in the use of digital technologies.[11][46][47][53–60] Thus, conducting a comprehensive assessment of nurses' digital health skills is critically important to support nurses through the digital transition process. To this end, the knowledge-attitude-practice (KAP) model has been employed to develop a survey tool for evaluating nurses' knowledge, attitudes and practices concerning digital health.

Theoretical framework: applying the KAP model to assess digital competencies in nursing

In this study, the KAP model was used to develop a survey instrument (online supplemental file 1) to examine

nurses' knowledge, attitudes and practices regarding digital health. KAB, also found in literature as KAP, is an important theoretical model of health education, which asserts that behaviour change is affected by knowledge and attitude.[61] Knowledge, attitudes and practices are critical components of behavioural change models. Knowledge refers to the understanding of information, which is the conscious and non-symbolic perception of meaning.[62 63] In accord with Ajzen and Fishbein, attitude refers to a positive or negative evaluation of an object.[62 63] Practice refers to regular activities influenced by widely shared social norms and beliefs.[64–67] The KAP model process originates from the learning theory of Bandura and the innovation diffusion theory.[64–67] According to Rogers (1995), members of a social system accept innovation through four stages over time. The stages include knowledge acquisition, persuasion, decision and confirmation. Additionally, Bandura (1976) suggested that individual behaviours are learnt through the social context. Another perspective used to consider behavioural change is Ajzen's (1991) theory of planned behaviour, which provides a framework for understanding the relationship between behavioural intention and behaviour.[68] For the relationship between attitudes and practices, Ajzen suggested that an individual with positive attitudes and behaviours would have a better motivating intention towards an issue. Ajzen further defined subjective norms and noted that perceived behaviour control would lead to the formation of behavioural intention. Subjective norms refer to individual social influence from peers or other important people who desire the individual to engage in a particular behaviour. Perceived behaviour control refers to the perceived ease or difficulty of performing the behaviour of interest, such as the availability or ability to use a new digital device. In general, the greater an individual's ability to control the three components (ie, attitudes towards a behaviour, subjective norms and perceived behaviour control), the greater the intention to enact a behaviour. In short, the research conceptual framework is shown in figure 1.

OBJECTIVES
Primary objective
To assess the level of digital competence and skills of nurses, including their KAB and perceptions towards major digital health technologies.

Specific objectives are as follows:
► To describe nurses' knowledge and attitudes towards major digital health technologies.
► To explore nurses' attitudes and perceptions regarding their level of confidence in using technologies in work activities.
► To describe nurses' perceptions of their skill level in using digital technologies.
► To investigate the influence of subjective and social norms on nurses' intention to use digital technologies in the workplace.
► To describe nurses' behaviours in using selected digital technologies in both work and personal settings.
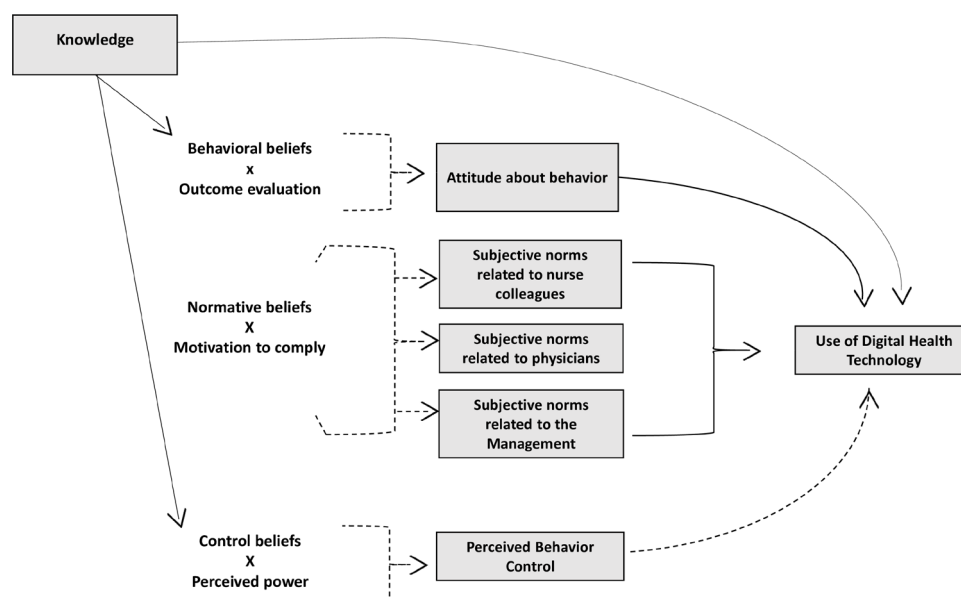

Figure 1 The diagram illustrates the Theory of Planned Behaviour (TPB) applied to the study of the use of digital health technologies among nurses. The diagram illustrates the three main determinants of intention and subsequent behaviour according to TPB: attitude towards the behaviour, subjective norms and perceived behavioural control. The model suggests that knowledge influences beliefs about the outcomes of technology use (behavioural beliefs) and the appropriateness of behaviour (normative beliefs), as well as control beliefs, which together shape an individual's attitude, perceived social pressures (norms) and the perceived ease or difficulty of performing the behaviour. These components collectively predict the actual use of digital health technology. The domain of subjective norms is broken down to show the different sources of social influence: fellow nurses, doctors and management.

Secondary objective

Through analysis of the survey results, the secondary objective is to identify key indicators that can inform the development of educational support programmes aimed at improving nurses' digital knowledge, skills and abilities, enabling them to effectively use digital health technologies in their daily practice. The Provincial Nursing Order of Naples will support the development and implementation of educational programmes to ensure that nurses possess the knowledge and skills necessary to use digital health technologies fruitfully in their clinical practice.

METHOD AND ANALYSIS

The survey with a cross-sectional design will be conducted between May and July 2024 to investigate the KAB of nurses regarding digital health.

Inclusion criteria

Nurses registered with the Nurses Provincial Order of Naples with an active Certified Electronic Mail (PEC) address will be included in this study.

Exclusion criteria

Nurses who are not registered with the Nurses Provincial Order of Naples; nurses no longer in active service; nurses who are not currently employed or practising as nurses; nurses who do not have an active PEC address.

Study procedures

The survey instrument (online supplemental file 1) has been developed through extensive literature search and from previously published studies. The self-administered questionnaire consisted of 66 questions exploring six domains relating to the respondents: (1) sociodemographic and practice characteristics such as gender, age, level of education, professional role, ward and job experience; (2) knowledge about information technology and the major digital technologies used in healthcare such as AI, chatbot, patient monitoring tool; (3) attitudes and perceptions towards the use of digital technologies in healthcare, as well as the level of comfort and confidence in using such technologies in work activities, the role of subjective and social norms in shaping the intention to use digital technologies, exploring the beliefs and expectations of colleagues, doctors and healthcare management regarding the use of digital technologies, as well as the perceived social pressure and normative influence in the workplace; (4) the factors that influence the intention to use digital technologies in work activities, as well as the main barriers to learning and using these technologies; (5) digital skills, and abilities behaviours on the use of digital technologies in work activity and instant messaging system in both work and personal settings; (6) sources of information on digital health and interest in acquiring additional information. To assess the knowledge, nine questions will be asked using a 5-point Likert-type scale with options for 'strongly disagree', 'uncertain', 'agree' and 'strongly agree'. To assess the attitudes, a total of 32 questions will be asked, 11 of them with responses using a 10-point Likert-type scale, ranging from 1 (I don't feel comfortable/I am not at all confident/Complete disagreement) to 10 (I feel very comfortable/I feel very confident/Complete agreement); 21 on a 5-point Likert-type scale with options for 'strongly in disagreement', 'uncertain', 'agree' and 'strongly agree' and two multiple-choice questions will be asked to assess intentions and major barriers regarding digital health (to be provided from a list).

Participants

Study population

To calculate the sample size, we used the formula $n = (Z^2 * p * (1-p))/E^2$, with a 95% confidence level and a 5% CI. We assumed a non-response rate of 25%. The reference population is represented by 16 000 registered nurses of the Nurses Provincial Order with PEC. We estimated that we needed a minimum sample size of 480 participants. The online survey will be created with the contribution of an IT expert from the Nurses Provincial Order of Naples. A test will be conducted with 20 professionals who will receive the survey via PEC email and report any technical issues. Subsequently, the initiative will be publicised through a *call for a survey* published on the institutional channels of Nurses Provincial Order of Naples. After 15 days from the launch of the call for survey, an email via PEC will be sent, containing a unique link/quick response (QR) code that will allow the professional to respond within 30 days to the online survey. The PEC channel is an IT system that allows legally valid emails to be sent and received and by law can be equated with a registered letter with return receipt. The content of the message is guaranteed and cannot be changed. Highly advanced security protocols certify that the text of the email cannot be manipulated. Another feature of PEC is the issuing to the sender of a receipt certifying that the message has been sent. Likewise, if you send a message to another PEC address, you will also receive a notice guaranteeing delivery. A date and time reference of the 'movement' of the message is also entered for each stage of the transfer. Any problems, such as failure to send or failure to receive, are also underlined by the system sending specific receipts. PEC messages are digital documents with legal value and must be stored according to the law for 10 years. The Nurses Provincial Order of Naples guarantees all its members a free PEC address. This service, in compliance with national legislation, is mandatory for professional nurses in Italy.[69] The sending of the email via PEC will be guaranteed by the research group in the period of December 2023 and February 2024, during which members will access their personal PEC addresses as they receive the instructions and payment slip for the annual fee necessary for the renewal of the Nurses Provincial Order membership.

Data analysis and statistics

The transmission of data for quantitative analysis will be limited to the purpose of the survey; the answers will be

anonymised before the data are organised and processed. Before conducting the statistical analysis, plausibility and consistency checks will be carried out alongside the exclusion of invalid cases. In order to meet the basic requirements for statistical analysis, a password-protected database—accessible only and exclusively by members of the research team—will initially be generated. For the analysis of the results, a unique code will be assigned to each participating professional, which will ensure compliance with the pseudoanonymisation procedures of the data during the coding and categorisation of the variables.

The data collected will be processed and analysed anonymously, in compliance with the current legislation on the processing of personal data (new European Regulation 2016/679). The owner of the data collected is the Nurses Provincial Order of Naples. In accordance with the provisions of Regulation (EU) 2016/679 (General Data Protection Regulation (GDPR)) and for the purposes of this study, a maximum lifespan of the collected data is set at 3 years.

To assess the reliability and validity of the questionnaire, a pilot test will be conducted on a group of 30 nurses and internal consistency and stability tests will be performed. Each participant will also be asked to rate the instructions and questionnaire items using a dichotomous scale (clear or unclear). Instructions, response format and instrument items that are unclear for at least 20% of the sample will be re-evaluated. Therefore, the minimum inter-rater reliability among the sample should be 80%.

A group of 10 digitally literate nurses will be asked to rate the relevance of each item on the questionnaire, using a four-point Likert-type scale (from completely irrelevant, 1 to completely relevant, 4) to compute the indices for quantitative content validation (face validity). Through the answers on a Likert-type scale, it will be possible to calculate the following indices: content validity ratio (CVR), Content Validity Index on the level of the individual items (I-CVI) and on the average of the I-CVI of the items of the entire instrument (S-CVI/Ave) and the Content Validity Index with calculation of universal agreement (S-CVI/UA). The achievement of quantitative content validity is set by the cut-off of 0.80 for the CVR and the cut-off of 0.78 for the I-CVI and 0.90 for the S-CVI/Ave. The process will continue until acceptable indices of content validity or equivalence are achieved.[70]

The collected data will undergo statistical analysis in three stages. First, descriptive analysis will be used to summarise the sociodemographic characteristics of the study population. Categorical variables will be presented using frequencies and percentages and will be further tested using Pearson's χ^2 test. Continuous variables will be presented as means and SD and will be further tested using the t-test for independent samples.

Second, univariate analysis will be performed using χ^2 test and Student's t-test, respectively, for the categorical and the continuous variables, and those that will be found with a p value ≤0.25 will be used as predictor variables into multivariate logistic and linear regression models. In the third stage, multivariate analyses will be conducted to identify the sociodemographic factors associated with digital competences and skills. The statistical analysis will be carried out using Jamovi software V.2.3.24.[71]

Patient and public involvement

There was no patient or public involvement in the design, execution, reporting or dissemination plans of our study.

ETHICS AND DISSEMINATION

Ethical principles will be followed in conducting the study in full compliance with the Declaration of Helsinki. Participants will be sent via PEC an invitation to participate in the survey with information on the purpose of the research, objective of the study, voluntary participation, anonymity, confidentiality and data handling process. After logging in, through the QR code, prior to completing the questionnaire, informed consent will be obtained in accordance with the requirements of the GDPR. Consent will be electronically documented when participants respond to the PEC message, which will include a consent statement and an acknowledgement of their understanding of the study details. This response will be time-stamped and securely stored, ensuring compliance with national regulations for electronic communications and data protection. This research will not require ethics committee approval, as it will not involve minors, direct or indirect physical or physiological harm, or clinical trials. We will guarantee anonymity and confidentiality at all stages of data collection and processing. No benefits will be offered for participation in the study. Study results will be published in international peer-reviewed journals, and will be presented at national and international conferences.

DISCUSSION

Over the last three decades, digital health technologies have gained increasing attention as a means to enhance the quality, efficiency and safety of healthcare. These technologies, which encompass mobile devices, wearables, apps, social media, telehealth and electronic medical records, offer numerous benefits. For instance, they enable health professionals to access patient data more easily and facilitate communication and coordination among stakeholders. They can also improve adherence to clinical guidelines, optimise resource use and reduce medication errors and adverse drug events. However, to fully leverage the advantages of digital health, healthcare workers need to be digitally competent and proficient. This is especially critical given the COVID-19 pandemic and the growing demand for remote care. Despite many healthcare professionals belonging to the 'digital native' generation, additional training and education may be necessary to fully embrace digital technologies and services. The digital transformation of the health sector requires that current and future health professionals acquire an appropriate

level of digital competence. Digital competence refers to nurses' ability to use digital technologies, tools and platforms effectively and efficiently in their clinical practice.[72] Improving digital literacy and competency can help ensure the successful adoption and implementation of digital health services and technologies in healthcare settings. Recently, core competencies for nursing education have been identified, including information technology, social media and emerging technologies for their impact on decision-making and quality of care.[52] It is no longer possible to think of digital literacy as a purely technical skill or as something reserved to a few experts. All individuals who work in various care settings must possess robust digital abilities based on knowledge, skills, attitudes and behaviours that enable them to provide the most effective and compassionate care for all.[73]

Studies in the literature show that people with better digital literacy tend to have more positive attitudes and behaviours towards the adoption of new technologies.[74] However, the implementation of information systems in healthcare settings may have negative impacts on end-users, including increased stress and strain resulting from the need to learn and adapt to the new technology in their workflow, as reported in previous studies.[53 75–77] In recent years, the assessment of nurses' digital competence in the provision of care in the health and social care sector has received attention in research.[47 57–59 72 78] The adaptation of and accessibility to digital health services in Italy vary significantly by region, with northern regions generally being more digitally developed and integrated than the southern regions. As a result, there is a clear need for active participation from stakeholders to support training that can improve the necessary knowledge and skills for the better use of digital technologies in healthcare processes, especially in the less digitally developed southern regions. The PNRR[41] has earmarked over €700 million to train 4500 healthcare professionals in managerial and digital skills by 2026, but more investment may be required to ensure equitable access to digital health services across all regions of the country. Therefore, it is crucial for Orders for Nursing Professions to support this transition through an integrated approach to promote and facilitate the acquisition and enhancement of digital skills through training programmes for all nursing professionals with the aim of improving the health of individuals and communities through available digital technologies.

Limitations
The study has various limitations, including the potential for nurses who are very unfamiliar with IT means to have difficulty reading the PEC, which may result in a biased sample. Another limitation is the recruitment method, which may lead to a sample of professionals who are already interested in digital health and may not be representative of the wider population of nurses. Additionally, there is a potential for non-response bias, as less digitally literate nurses may be less likely to participate in the survey in the future, leading to an incomplete representation of the population. Another limitation is the survey's reliance on self-perceived digital competence, which may not accurately reflect the actual use of digital health technologies. The study's findings may also have limited generalisability, as it is conducted in a specific geographic context and may not be applicable to other nursing settings. Finally, there is a possibility that some participants may not fully comprehend the survey questions or provide socially desirable responses.

CONCLUSIONS
The effective use of digital technologies by health professionals can bring significant improvements in healthcare services and help improve the health of individuals and communities. Additionally, the results of the study can provide a good starting point for the development and implementation of education programmes related to eHealth and telemedicine, thereby promoting the harmonisation of such programmes.

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