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Digitizing nursing: A theoretical and holistic exploration to understand the adoption and use of digital technologies by nurses

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Abstract

Background: With healthcare undergoing rapid digitalization, the effective integration of new technologies is crucial for nursing professionals, who form the largest group in the healthcare workforce. However, barriers within the nursing profession may impede digitalization efforts, leading to under utilization of available technologies and missed opportunities for enhancing healthcare quality and population health.

Aims: This article aims to investigate the adoption and use of digital technologies by nurses, considering how key demographics, such as gender, age, and voluntariness of technology use, interact to influence their acceptance and utilization of these technologies.

Methods: Employing the Unified Theory of Acceptance and Use of Technology (UTAUT) as a framework, we conducted a discursive exploration, supplemented by a literature review from diverse academic sources. Keywords related to UTAUT, digitalization, nursing practice and technology adoption were searched on PubMed, CINAHL and Google Scholar. Additionally, UK government and professional regulator reports were examined to understand current recommendations concerning digital technologies in nursing practice and the profession's demography. Searches focused on moderating factor domains, and the last search was conducted on 26 April 2023.

Results: The study revealed that the successful implementation of digital technologies in nursing practice requires a nuanced understanding of the nursing workforce's characteristics and preferences. Gender, age and voluntariness of technology use were found to intersect and influence nurses' acceptance and utilization of digital tools.

Discussion: By applying UTAUT in the context of nursing, this study highlights the importance of tailored implementation strategies for digital technologies. A technologically deterministic perspective is insufficient; instead, consideration of social factors specific to nursing is essential for successful adoption.

Conclusion: To maximize the benefits of digitalization in healthcare, it is imperative to address the barriers faced by nursing professionals. A comprehensive understanding of how key demographics impact technology adoption will inform targeted strategies, enhancing the engagement of nurses with digital tools and fostering innovation in healthcare practices. Further research and primary data are needed, but this study lays the foundation for future advancements in digital healthcare integration for nursing professionals.

Relevance to Clinical Practice: The issues highlighted in this article are relevant to nurse leaders and those responsible for implementing technologies within nursing contexts. They are also relevant to technology developers who may benefit from considering the evidence associated with the moderating demographic factors highlighted in this article. Without a holistic approach to the implementation of technology, challenges associated with the use of digital technology by nurses are likely to persist. By considering the moderating demographic factors highlighted within the UTAUT (age, gender, voluntariness of use and experience) nurse leaders and technology developers may have greater success obtaining greater clinical outcomes from digital technology. This work was completed in 2022.

No Patient or Public Contribution: Due to the focus of this article being one on professional challenges within the nursing profession, no involvement from patients or the public was sought.

KEYWORDS
acceptance, age, digital, diversity, gender, innovation, technology, UTAUT

1 | INTRODUCTION

The advent of the fourth industrial revolution has seen digital technologies, such as smartphones, social media, digital resources and software applications introduced into all aspects of life and the increasing digitization of working practices worldwide (Susskind & Susskind, 2016). The COVID-19 pandemic has also hastened the adoption of new digital technologies in many industries. In the context of healthcare, it is arguable that digital transformation is directly linked with health professionals' acceptance and use of technologies, alongside having the necessary digital skills . This has become a requisite for safe and effective service delivery in an increasingly digital environment.

The value of using technology in healthcare has inspired some contemporary healthcare theorists to suggest that technological competency is itself an expression of caring (Krel et al., 2022; Locsin et al., 2021). The authors of this theory emphasize that technological developments are mechanisms to inform care and that the competent use of technology can enable that (Locsin et al., 2021). The creation of new technologies by health professionals has also been suggested as an equally important expression of care (Bahari et al., 2021). Indeed, the exploitation of digital technologies to improve clinical outcomes and better understand the needs of patients has been the focus of much discussion recently (Tortorella et al., 2021). This has notably been highlighted by the high dependence on rapid access to centralized healthcare data collected digitally throughout the COVID-19 pandemic which was crucial to support decision making by senior healthcare leaders (Budd et al., 2020).

The use of big data to support developments in healthcare is arguably reliant on digital technology usage on a broad scale. Without widescale usage, staff investment in accurate data input and operation and well-integrated digital systems, the data yielded from our digital technologies is of little value. Healthcare professionals must be able to recognize the potential value of technology and data and ideally be involved in the development of new digital infrastructure to ensure that digital technologies work for our healthcare systems, our patients and answer the questions which traditional research methods are unable to answer. Existing research on the utilization of such technologies has found improved health behaviour and treatment compliance (Ibrahim et al., 2022), the satisfaction of patient information needs (Allen et al., 2016; Garwood-Cross et al., 2021; Vasilica, Garwood-Cross, et al., 2021; Vasilica, Oates, et al., 2021) and improved service metrics (Wynn & Scholes, 2022). Digital technologies can be utilized in a number of ways such as utilizing digital data to improve health research, joining up provision between services and improving patients' self-management of conditions to influence health outcomes.

2 | BACKGROUND

In nursing practice, despite the advantages of utilizing digital technologies, there are challenges associated with implementing and sustaining their use. For example, in a recent survey of wound care clinicians, predominantly nurses, in the United Kingdom (UK) almost

none used contemporary smartphone technology in their practice despite 99% of study participants having access to smartphones and 58% having access to more than one device (Wynn & Clark, 2022a, 2022b). Similar findings have been noted in relation to the adoption of electronic health records (Arikan et al., 2021) despite being a key focus of contemporary digitalization efforts which have repeatedly failed to materialize for over 20 years (Burke, 2002; Rumball-Smith et al., 2020). This may be due, in part, to resistance to an ever-shifting technological landscape. In 2018, the UK Health Secretary ordered that fax machines be phased out from the National Health Service (NHS) after it was discovered that more than 8000 were still in use in the NHS trusts, and placed a ban on their use from 2020 to hasten a move towards more modern technologies such as secure email for communication (Department of Health and Social Care, 2018). However, in 2022 it was reported that over 800 fax machines are still in use in NHS trusts (Gross, 2022) showing a potential resistance to modernize in line with changes in technology.

Nurses' resistance to digital technology implementation is not a new phenomenon (Kirkley & Stein, 2004; Salzmann-Erikson & Eriksson, 2016; Sweis et al., 2014; Timmons, 2003; Wilson, 2002). A study by Timmons (2003) highlighted nurses resisted the implementation and use of computer systems in a variety of ways including avoidance, extensive criticism and in rare cases refusal of use. In some cases, this is linked with nurses' concerns about reliability, over-reliance on technology, the degradation of skills or needing to complete digital plans away from patients, which mirrored findings from Wilson (2002). Whilst these studies are now approaching 20 years old, they highlight that resistance to a fast-changing technological landscape has been observed in nurse populations for some time. Moreover, Timmons (2003) highlights that resistance to technology should not just be seen through the lens of irrational technophobia but should be considered an indication of systems failures. We take this argument a step further to suggest that it may also be indicative of failures to provide implementation strategies that acknowledge the population the technology is being implemented within. Contemporary studies and reviews typically focus on technologies in terms of their functionalities, usability, acceptability, uptake, efficacy, and impact on health outcomes, with little prior emphasis placed on the needs, expectations and requirements or technological habits of the target demographics of the digital technology users themselves.

In this article, we demonstrate how the moderating factors identified within the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) can be used as a lens to undertake a holistic analysis of the nursing profession for digital technology adoption. As nursing roles and populations vary from country to country, we use the UK as a case study to demonstrate this however, the UTAUT framework can be applied to other countries and health professions, and we encourage other scholars to do so.

In doing so, we aim to identify what understanding this professional population can tell us about how best to implement and develop digital technologies for use with and by nurses for technology acceptance in the profession and identify the gaps in knowledge to be filled by future study. Previous reviews of research using the UTAUT have identified that these moderating factors are rarely included in analyses (Dwivedi et al., 2011) and it is rarely used in healthcare contexts compared with the other industries (Williams et al., 2015). We suggest that by using the UTAUT, gaps in literature and understanding can be identified, and thus targeted for future primary research to fill the gaps required for a holistic understanding of technology implementation in healthcare practitioner populations, in this case, nursing.

3 | THE UNIFIED THEORY OF THE ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

The success of technological innovations is not determined solely by the value of technologies themselves. It has long been argued in the field of Science and Technology Studies that there is a mutual shaping between technologies and humans, particularly by actor network theory (ANT) scholars (Callon, 1989; Latour, 1987, 2005; Law, 1992, 2016). Applying this lens of the mutual shaping of technology to digitized nursing, and considering particularly the literature about nurses' resistance to technologies (Kirkley & Stein, 2004; Salzmann-Erikson & Eriksson, 2016; Sweis et al., 2014; Timmons, 2003; Wilson, 2002), we can see why more thought must be given to the ways nurses and technologies interact. Taking an example from Timmons (2003) study, a new electronic care planning system was introduced, nurses are concerned about how the technology shapes them—they fear it will make them over-reliant on technologies, will degrade their skills, and that system issues will impact the care of their patients, therefore, they resist the technology by avoiding its use, updating notes on article and in extreme cases outright refusal to engage with the technology. In a situation like this not only are nurses concerned about how the technology will impact them, but their resistance impacts the implementation of the technology itself. If a technology is not utilized effectively then it may be considered inefficient or have diminished impact, potentially affecting decisions to continue broader implementation. Acceptance of technology is believed to influence productivity, efficiency and effectiveness (Bhattacherjee & Sanford, 2006). Therefore, it is important to understand nurses' technology acceptance to successfully implement new innovative technologies with this professional group.

Technology acceptance and consumer behaviour research dates to 1978 (Du Plessis et al., 1990). There are a variety of different theories that can be applied when considering technology acceptance and these fall into three main categories; social psychology, information system management and behavioural psychology (Venkatesh et al., 2003). These theories include the Technology Acceptance Model, Theory of Planned Behaviour, Social Cognitive Theory, Innovation Diffusion Theory and the Motivational Model. However, Venkatesh et al. (2003) suggest these theories can be limited in unpacking more complex technologies and in response, developed the UTAUT via a synthesis of several of these earlier theories of

technology acceptance. UTAUT was therefore selected for this article as it combines the features of alternative theories and provides a more holistic view of technology use and acceptance.

The theory identifies four predictors of users' behavioural intention with technology including performance expectancy (the degree to which users think a system will help them gain job performance), effort expectancy (the ease of use of the system), social influence (the degree to which individuals perceive that others think they should use a system) and facilitating conditions (the perception of an individual that their organizations technical infrastructure is able to support the use of the system). In addition, UTAUT identifies four social/demographic factors; gender, age, experience and voluntariness of use. These social demographic factors intersect to influence a user's perception of performance expectancy, effort expectancy, social influence and facilitating conditions, thus impacting their behavioural intention and use behaviour of technology as seen in Figure 1.

As technology usage is somewhat linked to demographic characteristics (ONS, 2020), UTAUT is the only theory providing a clear link between immutable demographic features such as gender and age, and factors which may be relatively consistent within a well-defined professional group (i.e. experience with technology and voluntariness of use) (Marikyan & Papagiannidis, 2021) as is possible within registered nurses working within a nationalized health system. Given nursing is uniquely non-diverse in relation to gender in particular, it is possible that this may exert a disproportionate moderating influence on interactions between technology and their acceptance by nurses. This may be compounded by the standardized training curriculums set by the Nursing and Midwifery Council leading to potentially homogenous experiences and expectations of the use of digital technologies in clinical practice along with the culture experienced within a nationalized health system. A recent systematic review indicated that the UTAUT is still valid and effective for predicting the use of technologies by healthcare professionals (Rouidi et al., 2022).

While the predictors on the left-hand side of Figure 1 are challenging to predict without specific primary data and are likely to vary considerably within different clinical contexts due to variations in leadership, culture and infrastructure. The moderating factors shown at the bottom of the diagram in Figure 1, specifically gender, age and voluntariness of use are arguably relatively predictable or stable within the nursing profession and can therefore be examined in greater depth to provide insights which may assist digital innovators hoping to implement technologies within nursing practice in a more general sense. Therefore, this article will focus on gender, age, voluntariness of use and experience, to identify existing knowledge of these areas of the nursing profession or where future primary data are required. The authors are also conducting a study to collect data from UK nurses on all the UTAUT domains, therefore, this article represents a first step in interrogating the key demographics and how they may impact the implementation of technology with nurses.

4 | DATA SOURCES

Although this article is discursive and not a systematic review of literature, the authors aimed to ensure that peer-reviewed literature was obtained from a range of academic sources. Keywords such as 'Unified Theory of Acceptance and Use of Technology', 'UTAUT', 'digitalization', 'nursing practice' and 'technology adoption' were searched on PubMed, CINAHL and Google Scholar to identify literature broadly related to the use of the UTAUT theory. UK government and professional regulator reports related to technology usage and nursing demographics were reviewed to gain insights into current recommendations related to digital technologies in nursing practice and the demography of the profession. In addition, searches focussed on the moderating factor domains were run on PubMed using the search statements below. The last search was run on 26 April 2023.

The details of the search statements used can be seen in Appendix 1. The searches were conducted and screened for relevance by two of the authors MW and LGC. UK sources were prioritized, however, where insufficient literature from a UK or nursing context was found, the authors noted the need for future primary

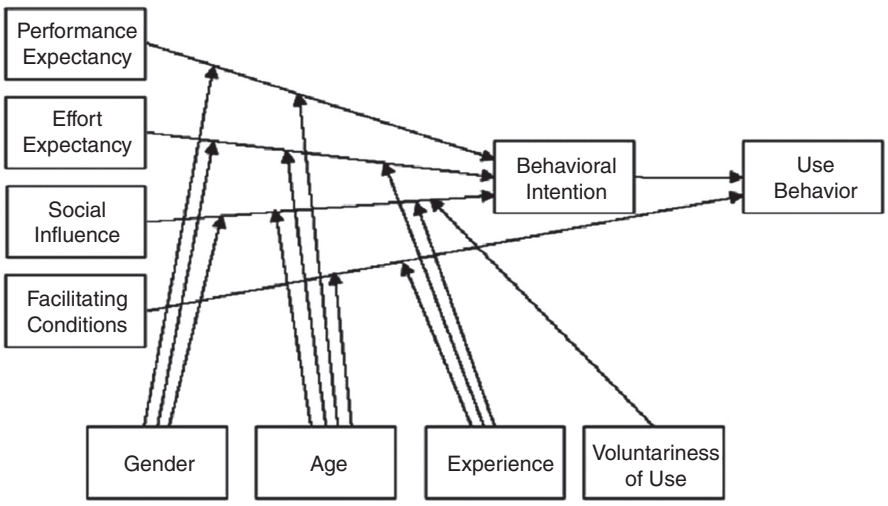

FIGURE 1 Unified theory of acceptance and use of technology (Venkatesh et al., 2003).

data and have drawn on data from other countries or broader studies to provide awareness of possible future findings.

5 | FINDINGS

5.1 | Who are nurses?

According to the most recent data available on the nursing profession in the UK, there were 704,520 nurses on the register in March 2022 (NMC, 2022). Of these registrants, 89% are female, typically between 31 and 50 years of age and are mainly of white British ethnicity (71.9%) and 24.7% from Asian and Black minority ethnic groups. Only a small proportion of nurses have recordable qualifications indicating further study ($n = 126,843$, 18%) although this may be an underestimation of nurses who have undertaken additional training/education as not all courses lead to recordable qualifications. Since 2013, all the nurses have been required to complete an undergraduate degree prior to registration as a nurse as such there is potentially a substantial proportion of nurses who do not have a university education and a demographic shift in relation to education is currently underway in the UK nursing context. Some changes in demographics are notable within the NMC (2022) data including a reduction in nurses from the European Union following the UKs exit from the EU in 2016 decreasing 4.8% from 35,115 to 28,863 over the 5-year period from 2017 to 2022. This has accompanied a 60.3% increase in nurses from outside the EU which have increased from 68,434 to 113,579 over the same period with most of these nurses coming from the Philippines and India. The data broadly indicate that the current nursing workforce is eclectic comprising both the UK and internationally trained nurses, some of which trained before 2013 when nursing became a graduate profession in the UK and as such their digital preparedness is likely broad.

However, from the NMC data, the key demographics of the UK nurse can be summarized as typically, female, aged between 31 and 50, educated to at least a diploma level and of white British ethnicity. It could, therefore, also be assumed that most UK nurses have experienced contemporary British digital culture and access to technologies as per current norms within the UK. According to the Office for National Statistics, in 2020, 96% of UK households had internet access, 76% of adults used internet banking and 87% shopped online. Of adults aged 25–34 years, 49% reportedly used virtual assistants, smart speakers or apps. This dropped considerably in those aged over 65 to just 17%. This data helps generate an image of the contemporary experience of the nurse and their potential relationship with technology. They are likely to use digital technology to manage their finances, utilize smartphone applications and possibly virtual assistants. This is suggestive of both a level of competency to use digital technology, good access to the internet and trust that these technologies are secure enough to manage their money with. Considering the above factors, it is necessary to review in more granular detail how these demographic factors may influence the acceptance and the use of technologies by nurses in the workplace.

5.2 | Gender

Nursing remains a predominantly female profession, with 24 million of the 28.5 million nurses globally being women (World Health Organization, 2019), and the UK nursing population being 89% female (NMC, 2022). The UTAUT highlights gender as a factor in the acceptance and use of technology, therefore, it is valuable to question what impact this might have in a majority-female profession, and how technology implementation for this population might be rethought accordingly. Our search identified no existing studies related to the impact of gender on the UK nurses' technology acceptance or usage, therefore, further research is required to draw clear understandings of how gender impacts acceptance in this population. Whilst no demographic group can ever be assumed to be homogenous in their thoughts, feelings or skills, by considering some of the existing literature around gender and technology adoption we may be able to reveal under-considered ways of supporting the technology adoption of nurses.

A review by Goswami and Dutta (2016) investigating differences in the usage of technology associated with gender highlighted several common factors across a range of technologies including the use of social media, e-commerce, online banking and e-learning platforms. Critically, the study reviewed studies from across the globe including from the UK, Malaysia, Nigeria, Singapore, Taiwan, Brazil and others indicating that consistencies in findings are unlikely an artefact of any country's unique cultural features with regards to gender. The authors found that females tended to use technology which requires less effort to use than men indicating that effort expectancy is a greater predictor of technology acceptance in females than males. Social influence was also found to be greater among females than males indicating that gender also moderates this predictor to a greater extent in female populations. Notably, this was also observed in the usage of technologies with females generally making more use of social media platforms and demonstrating more sensitivity to customer reviews when using e-commerce services than males. Critically, females were reportedly more likely to adopt technologies due to social influence than males who are more likely to adopt technologies due to personal choice. Other patterns identified included increased concerns about privacy by females than males and variations in perceptions of self-efficacy. Females reportedly demonstrated higher levels of anxiety and reduced perceptions of self-efficacy in relation to using technologies than men. However, this study examined the use of technologies by individuals for personal reasons and not in a work context. Despite this, the clear differences between how males and females use technology are arguably likely to be consistent in its moderating impact even in a professional context and should be considered. The results of a recent study evaluating the adoption of digital technologies in nursing practice in Germany reflect these findings, reporting that usability was the dominant reason for the non-adoption of technologies alongside perceptions of benefits (Seibert et al., 2020).

The findings of the Goswami and Dutta (2016) study were repeated in a later systematic review and meta-analysis examining

gender attitudes towards technology by Cai et al. (2017). This later review also used a sample drawn from across North America, Europe, Asia and others and examined the data across a 20-year period. They found that males showed more favourable attitudes towards technology, while females demonstrated lower self-efficacy and levels of belief in the utility of technology. Notably, the authors reported that, across the 20-year period, the data indicated little change in lower levels of positive attitudes towards technology among females despite changes in the capabilities and ubiquity of technology in society. It has been proposed that these variations in attitude and perception may be a result of the widespread perception of technology as a male-dominated field, although there has been little enquiry into the causation of varying attitudes between genders. Given the specific nature of the disparities between genders it appears unlikely that focussing on the unique factors influencing acceptance of technology by females will reduce their usage by the minority of male nurses. However, it is evident that failing to consider these factors may have a disproportionate impact on the majority of the nursing profession and could risk a reduction in the acceptance and sustainability of technologies within nursing practice. Notably, the Cai et al. (2017) study demonstrated that the differences in attitudes towards technology between males and females were both statistically significant and stable over the period of 17 years for which data were available. Whilst the reasons for this remain poorly understood, it highlights considerations when implementing technologies as to how the benefits, designs and skills required are presented.

These findings raise interesting considerations for how we introduce digital innovation into healthcare systems. When introducing new technologies into healthcare, the focus is often on the time and money-saving benefits of these technologies as motivators for adoption. In fact, in most cases, demonstration of economic benefit is essential for end-users to justify adoption of the technology (Guo et al., 2020). Thereby creating a paradox whereby no successful implementation means no evidence and therefore no adoption and vice versa. However, taking the UTAUT into consideration highlights that to effectively implement technology in a female-dominated profession such as nursing efforts must be made to appeal particularly to the factors that motivate females to adopt technology, such as social influence. This might be done by highlighting the benefits to patients' well-being, sharing the value of building communities of practice through technology, or introducing professional role models to emphasize the benefits of technologies in the workplace. Likewise, recognizing that effort expectancy is important to women provides opportunities for those developing technologies for the female-dominated nursing profession to account for the importance of ease of use, with intuitive and effective user design, rather than adding unnecessary features which may over-complicate the technological innovation and have a negative impact on user perceptions of effort expenditure needed to adopt the technology.

Considering the existing research on gender variations in technology acceptance and use, increased efforts may also be required to improve perceptions of self-efficacy when it comes to digital skills with nurses. At present, there is a scarcity of studies to understand how nurses as a professional group perceive their digital skills, and further research is needed to develop this understanding. In 2017, Health Education England (HEE) and the Royal College of Nursing (RCN) produced a report on improving confidence the digital literacy of the nursing profession. Within which definitions of digital literacy, 'e-nurse' and approaches to improving digital literacy are described. However, the research from which this report was based did not focus on the nursing profession but instead looked at data related to trainees, learners and employees in healthcare and industry more widely and is therefore unlikely to account for the unique demographic features of the nursing profession (de Normanville et al., 2016; de Normanville & Scott, 2016). Critically, the literature review underpinning the HEE/RCN report found that there is little, if any evidence of evaluation of the impact that a digital literacy strategy has upon any specific workforce's performance (de Normanville & Scott, 2016).

Given that nursing is a female-dominated profession, and the research suggests women may have lower confidence in their digital skills, efforts to improve nurses' perception of their digital skills and develop those skills further may aid in the adoption of technologies within the profession. This could be in the form of dedicated digital skills training programmes utilizing pedagogical approaches which build confidence in technology and harness the impacts of social influence to moderate intentions to use technology in future practice. This would also be consistent with the World Health Organization's (2021) strategic Directions for Nursing and Midwifery which emphasizes the need for nurses and midwives to be educated with cross-cutting competencies including culturally appropriate care and the use of digital technologies.

5.3 | Age

In a UK context, the NMC publish descriptive statistics of registrants ages, which gives us an insight into the age demographics in nursing and midwifery. This data (NMC, 2022) highlights that the profession is an ageing profession with most nurses falling between ages 31 and 50. Beyond the descriptive statistics published by the NMC on the age of UK registrants, there is currently little data on the age distribution of nurses working at different levels within the NHS. In addition, due to the relatively unstructured nature of nursing careers in the UK, it is difficult to predict at what age a nurse might be at any given level within the professional hierarchy. Compounding this, there is currently no requirement to register senior positions such as managerial or most specialist clinical positions which may indicate positions of formal authority and potentially greater social influence over more junior nurses. This makes it challenging to predict how age may influence nursing services as there is currently no data available indicating the age diversity of nurses in roles where key decisions might influence the adoption of digital technologies.

Whilst there appear to be no studies exploring the role of age in a UK nurse-only context, a recent study looking at the adoption of mobile health technologies and recommendations of their use for

patients by NHS health professionals, including nurses, found that age was a significant factor (Leigh et al., 2020). The authors noted that HCP over the age of 46 were considerably less likely to recommend the use of mobile health technologies to patients. Although it is important to note that nurses made up only a small proportion of the sample in this study ($n = 27/185$). This may reflect higher self-reported digital competence among younger HCP which was indicated in a study of 27 UK primary care facilities (Hammerton et al., 2022). A recent Italian study by Barchielli et al. (2021) investigating nurses' acceptance of innovations in technology-intensive contexts also supports the hypothesis of age as a key factor in the nursing-technology context. They found that age is a key moderator for social influence and that older nurses appeared to be influenced less by social factors. The authors suggest this may be because younger nurses are more dependent on others whilst older nurses may feel more confident and therefore less influenced by others. This may indicate the compounding impact of older nurses who are more likely to be in positions of formal authority having a disproportionate influence over younger nurses who are more likely to yield to their social influence as leaders because of both their younger age and being (mainly) female. However, there is currently limited evidence on how age impacts on technology usage among nurses.

Age should be included as a variable in future studies evaluating the usage of technology by nurses to provide more evidence on how this factor affects technology usage. These sentiments are reflected in the recently published 'What Good Looks Like Framework' by NHS England (2021), which highlights the need for a people-centred approach to the digitalization of healthcare services.

5.4 | Voluntariness of use

This moderating factor relates to the degree to which the use of technology is perceived as being voluntary or of free will. Currently, nursing teams have varied abilities to either adopt or reject new technologies dependent on factors such as budgets, leadership and cultural factors. However, as mentioned at the beginning of this article, there have been instances of the use of technology being forcibly altered within the NHS, such as the ban on fax machines by the Department of Health and Social Care (2018). Whilst the authors were unable to locate data on forced changes to UK nurses' use of technology, Chiu and Ku (2015) noted that when physiotherapists in Hong Kong had electronic health records made mandatory, dependent on ease of use, they were more resistant to these technologies than they had been when they were voluntary. Whilst this study was not conducted with nurses, it highlights the potential resistance against the mandatory use of technologies in a healthcare context. A broader study of HCP by Leigh et al. (2020) also found that an 'NHS stamp of approval' may increase the likelihood of HCP recommending the use of mobile health applications to patients. However, again this study did not focus explicitly on nurses and may not account for the more specific social and cultural influences guiding perceptions of voluntariness of use in the nursing context.

This could be compounded by the lack of inclusion of nurses in the design and development of new technologies. Nurses are rarely involved in the development of new technologies (Seibert et al., 2020) and have mixed feelings about the mandatory implementation of technology (Nguyen et al., 2016). These studies highlight the need for nurses to be engaged in the creation and implementation of technologies to increase their voluntariness of use. The impacts of mandatory use of technologies may also hinder innovation and degrade nurses' sense of agency to act within the new universal technological domain. Rather, nurses should be encouraged to increase their agency as digital healthcare workers and see themselves as digital innovators able to actively shape technologies useful to their practice, rather than having technologies introduced compulsorily. Seibert et al. (2020) support this notion and argue that greater emphasis on multidisciplinary development teams is required to support innovation. Curtis and Brooks (2020) highlight in their UK study that co-creating nurse-led initiatives for implementing digital health technologies in nursing homes required a whole-team approach that listens to nurse's concerns and prepares the nursing home workforce for digital implementation. According to Booth et al. (2021), nurses must adapt to the digital age by re-conceptualizing nursing practice to account for the new demands on nursing professionals with regards to skills, knowledge and leadership and the disruption to traditional nurse–patient relationships caused by technology. The Philips Ives review is currently underway in the UK to generate evidence and inform strategy to ensure that nursing professionals have the knowledge skills and education to operate effectively in an increasingly digital care environment.

5.5 | Experience

While numerous studies have delved into nurses' experiences with specific technologies in practice, comprehensive research focusing on nurse experiences of technology use and implementation in a broader sense remains scarce. For instance, we could find no investigations into nurses' personal philosophies concerning digital technologies based on their experiences, which may subsequently influence future or ongoing interactions with digital technologies. However, comprehending nurses' experiences with technology and their capabilities related to digital skills is crucial as healthcare systems progressively adopt digitization. A study by Hammerton et al. (2022) identified that self-reported competence was higher for electronic patient record (EPR) technology than patient apps and wearables and social media among primary care staff in the UK potentially reflecting the level of experience associated with these technologies. However, this study was not focussed on nurses and data were not disaggregated to allow a closer analysis of this specific population.

Inadequate digital competence has given rise to new types of potential healthcare-associated harm. A prime example is e-iatrogenesis, described by Weiner et al. (2007; p. 1) as 'patient harm caused at least in part by the application of health information

technology'. Often, substandard medical data processing systems contribute significantly to medical errors (Adane et al., 2019), such as medication errors (Gupta & Moran, 2018). The experiences of nurses in relation to digital technology must therefore be the focus of further investigation to help guide efforts to upskill the profession and focus on technologies that nurses may have less experience with.

6 | DISCUSSION

This article has considered four elements impacting UTAUT (gender, age, voluntariness of use and experience) which intersect with performance expectancy, effort expectancy, social influence and facilitating conditions. By interrogating categories, this article lays the foundation for further exploration of the UTAUT in nursing and highlights the need for further primary data on UTAUT domains in the UK nursing population. To account for the moderating impacts on performance expectancy, effort expectancy, social influence and facilitating conditions, individuals aiming to implement or develop new technologies for nurses must consider these factors. Crucially, the evidence for how these demographic characteristics intersect to influence the use and acceptance of technology must be investigated further to support ongoing digitalization efforts within the nursing profession.

Recognizing how these elements may have a mediating effect on other aspects of technology acceptance and use also allows us to consider how those charged with implementing technology in healthcare can alter their implementation strategies to appeal to nurses' unique intersections. It is also valuable to consider how this mapping of healthcare professionals' unique demographics and perspectives using UTAUT may be valuable in other health professions, particularly those where the demographics of the profession are more homogenous and may have strong moderating impacts on overall technology acceptance and use.

In addition, performing this first stage of a holistic UTAUT analysis of the nursing profession has highlighted that despite the implementation of technology within the UK NHS being a process that has been going on for 20 years (Timmons, 2003; Wilson, 2002), the literature and data required to perform a full holistic UTAUT analysis of the nursing profession in relation to technology acceptance and use is still not readily available. As such, the authors have used the framework of both UTAUT and ANT discussed in this article to shape the collection of data from the UK nurses about their digital capabilities, perspectives on digital technologies and training needs for digitalization.

7 | CONCLUSION

Healthcare services are undergoing transformative changes due to rapid advancements in technology, particularly digital technologies. To remain relevant and effective, nurses must adapt to this new context, which requires a shift in the epistemology of professional nursing to account for the digital environment in which care is delivered. The development, implementation and adoption of new digital technologies that enhance nursing capabilities should be prioritized by nursing and healthcare leaders, with nurses as a key focus in the process of digitalization. Understanding the demographic makeup of the nursing profession, including gender, age and nurses' voluntary use of technologies according to the UTAUT, is crucial for gaining a clearer analysis of the nursing situation and supporting ongoing efforts to engage nurses in digitalization.

Further research is needed to gain insight into how the factors discussed in this article influence nurses' adoption of digital technologies. However, current data suggest that several factors may increase technology adoption among nurses. These factors include placing greater emphasis on usability rather than functionality, involving influential nurses as social influencers during implementation, incorporating feedback systems into digital technologies to visualize their impact on patient care, promoting age diversity among nurse leaders, and better understanding nurses' perceptions of their voluntary use of technologies. It is evident that nurses must take on greater roles in the development of new technologies, which will require the acquisition of new digital skills not traditionally included in nursing curricula, such as proposing new technology initiatives or improving existing ones.

Recommendations include considering the UTAUT factors in the implementation of new technologies within the nursing profession and conducting similar work in other healthcare professions with slightly homogeneous demographics. Demographic patterns, including age, gender and education level, can influence nurses' perceptions of digital technologies and their willingness to adopt them. Additionally, social and organizational factors, such as perceived usefulness, ease of use and support from colleagues and management, play a critical role in shaping nurses' attitudes towards digitalization.

AUTHOR CONTRIBUTIONS

MW, LGC, CV, MG, VH, NP—made substantial contributions to conception and design, or acquisition of data or analysis and interpretation of data; Involved in drafting the manuscript or revising it critically for important intellectual content; Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content; Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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APPENDIX 1

Gender:

((Nurs*[Title/Abstract]) AND (technology[Title/Abstract] OR digital[Title/Abstract] OR electronic health record[Title/Abstract] OR EHR[Title/Abstract] OR app[Title/Abstract] OR devices[Title/Abstract])) AND (gender[Title/Abstract] OR female[Title/Abstract] OR male[Title/Abstract] OR women[Title/Abstract] OR men[Title/Abstract]) AND (acceptance [Title/Abstract] OR adoption [Title/Abstract] OR usage[Title/Abstract] OR utilization [Title/Abstract] OR implementation [Title/Abstract]) AND (UK[Title/Abstract] OR United Kingdom [Title/Abstract] OR England [Title/Abstract] OR Northern Ireland [Title/Abstract] OR Scotland [Title/Abstract] OR Wales [Title/Abstract])

Age:

((Nurs*[Title/Abstract]) AND (technology[Title/Abstract] OR digital[Title/Abstract] OR electronic health record[Title/Abstract] OR EHR[Title/Abstract] OR app[Title/Abstract] OR devices[Title/Abstract])) AND (age[Title/Abstract] OR older[Title/Abstract] OR younger[Title/Abstract] OR young[Title/Abstract]) AND (acceptance[Title/Abstract] OR adoption[Title/Abstract] OR usage[Title/Abstract] OR utilization[Title/Abstract] OR implementation[Title/Abstract]) AND (UK[Title/Abstract] OR United Kingdom[Title/Abstract] OR England[Title/Abstract] OR Northern Ireland[Title/Abstract] OR Scotland[Title/Abstract] OR Wales[Title/Abstract])

Voluntariness of use:

((Nurs*[Title/Abstract]) AND (technology[Title/Abstract] OR digital[Title/Abstract] OR electronic health record[Title/Abstract] OR EHR[Title/Abstract] OR app[Title/Abstract] OR devices[Title/Abstract])) AND (voluntariness [Title/Abstract] OR autonomy[Title/Abstract] OR choice[Title/Abstract] OR decision-making[Title/Abstract]) AND (acceptance[Title/Abstract] OR adoption[Title/Abstract] OR usage[Title/Abstract] OR utilization[Title/Abstract] OR implementation[Title/Abstract]) AND (UK[Title/Abstract] OR United Kingdom[Title/Abstract] OR England[Title/Abstract] OR Northern Ireland[Title/Abstract] OR Scotland[Title/Abstract] OR Wales[Title/Abstract])

Experience:

((Nurs*[Title/Abstract]) AND (technology[Title/Abstract] OR digital[Title/Abstract] OR electronic health record[Title/Abstract] OR EHR[Title/Abstract] OR app[Title/Abstract] OR devices[Title/Abstract])) AND (experience[Title/Abstract] OR usability[Title/Abstract] OR satisfaction[Title/Abstract] OR perception[Title/Abstract] OR opinion[Title/Abstract]) AND (UK[Title/Abstract] OR United Kingdom[Title/Abstract] OR England[Title/Abstract] OR Northern Ireland[Title/Abstract] OR Scotland[Title/Abstract] OR Wales[Title/Abstract])