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An exploration of factors involved in the roll out of a digital application in breast services: A case study approach

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ABSTRACT

Introduction: Acceptance of new technologies in health care, by those who use them as part of their role, is challenging with confounding contextual factors surrounding the acceptance of technology. As healthcare is rapidly digitising, stakeholder groups should be included in each stage of evaluation and implementation to allow opportunities to influence and contribute to digital health policies.

This research employed a case study methodology to initiate an exploration into the factors associated with implementing a digital application into a mammography service. It examined the initial implementation and subsequent impact of the rollout of a digital application (VA) within a breast service in South Australia.

Methods: Stakeholders' opinions on team performance and feedback mechanisms of the digital application were evaluated through a staff questionnaire distributed through an online survey JISC.

Results: The incorporation of digitised technology into a service is evidently met with challenges. Although there is potential value in utelising automated feedback for workflow improvement and patient services, it appears imperative to provide targeted and developmental resources for educational development and staff well-being during the implementation phase.

Conclusion: This case study approach delves into key discussion areas and serves as the initial insight into the implementation of a digital application. It could be regarded as a foundational reference for future evaluations of digital applications.

Implications for practice: Research around digital fluency within the radiography profession requires further consideration. Under-utilisation or resistance may result in missed opportunities to enhance patient experiences and care outcomes and support staff wellbeing. Therefore, continued engagement and the encouragement of user feedback during the implementation phase are crucial to demonstrate future acceptance of digital applications in clinical settings.

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Introduction

The primary aim of this study is to initiate an exploration into the factors associated with implementing a digital application into a mammography service. To achieve this, a case study approach was employed. With careful consideration given to the rapidly evolving nature of innovation, it is acknowledged that this case study provides a preliminary insight into any challenges or positive outcomes encountered during the rollout of a digital application within a designated service. Consequently, the conclusions and theoretical proposals resulting from this study should be taken within the confines of this instance, though could be employed as a basis for guiding forthcoming research in this field.

Within the radiography workforce, there is a growing requirement for staff to possess digital competence and technological proficiency, aligning with the Department for Education's Essential Digital Skills Framework,[1] the Digital Competency framework for Allied Healthcare Professionals (AHPs),[2] and supporting the future vision established by Health Education England (HEE) through the National Health Service (NHS) Digital Academy.[3] Despite the evident advantages of automated processes, the acceptance of new digital technologies, applications, or AI systems in healthcare is

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challenging, and ensuring their sustained use presents considerable obstacles[4,5,6.] Factors influencing the acceptance of digital processes and technology encompass organisational and social environments, routines, political, economic, and legal climates, as well as participation cultures in the workplace.[6]

Acknowledging the diverse stakeholder groups and involving them in the evaluation process during implementation is crucial,[6,7] providing opportunities for them to influence and contribute to digital health policies.[7,8] It is recognised that individuals may exhibit varying rates of acceptance and may encounter resistance, which can be mitigated through comprehensive training on how the technology operates, fostering a broader understanding, acceptance, and commitment to the technology itself.[6]

The integration of new digital technology or AI systems within the NHS faces significant challenges, possibly attributed to the dynamic landscape and financial constraints. However, practitioner competence in the use of technology itself serves as a mechanism to inform care and best practices.[9] A "digital divide" highlights proficiency differences between senior and junior colleagues,[10] emphasising the necessity for comprehensive training to all practitioners on new technologies or systems to inform care effectively.[11]

The technology acceptancy model (TAM)[12] centres around two variables of perceived usefulness and ease of use. However, perception of the new technology is key to peer-group acceptance; independent on the usefulness of the technology.[13] Wynne and colleagues[14] discuss the perceived value of acknowledging the population that the new technology was implemented within, using the Unified Theory of Acceptance and Use of Technology (UTAUT)[15] to assess technology acceptance within a nursing population.[14] Bhattacherjee and colleagues in 2006[16] demonstrated the resistance to, and fear of, change with use of an electronic care planning system; staff feared degradation of skills, impact on patient care and concerns about productivity, though, as technology was accepted, productivity and efficiency were improved.[16]

The main aim of this study was to explore factors involved in the roll out of a digital application within a breast imaging service. It is recognised that recent studies have not fully considered the role of implementation,[7,8] though some have acknowledged the need for formalised education to prepare the current and prospective workforce to safely and efficiently navigate a digital future.[8] The new digital application, Volpara Analytics (VA),[17] was installed in a mammography centre; this digital automated software application (VA) analyses mammography images, using algorithms, to provide a quantitative assessment of image quality, providing a platform to assess mammography image quality for both practitioner and service leads. By virtue of its system outputs, VA possesses the capability to concurrently analyse multiple facets of image quality. Consequently, it could be suggested that it may contribute to the ongoing education of the imaging team, facilitate the maintenance and adherence to imaging standards, and promote consistency in both image quality and client experience.

Before the implementation of this system, staff within this service evaluated their positioning using a subjective grading system known as PGMI (Perfect, Good, Moderate, or Inadequate). Previous research[18,19,20] has highlighted the absence of standardised positioning techniques and inconsistent breast compression in successive screening examinations. It would seem imperative that any new digital application introduced has the potential to facilitate improvements in this domain.

Methods

Employing a case study methodology, this study examined the initial implementation and subsequent impact of the rollout of a digital application (VA) within a breast service in South Australia. The evaluation of team performance and feedback on VA metrics was conducted through a staff questionnaire, approved by the University Research Ethics Committee.

The questionnaire was developed by the research group and piloted with two academic and clinical staff members, one from the UK and one from Australia. The process considered variations in terminology between the countries, with agreed-upon terms discussed during the various stages of development.

All staff within this service (50) were approached through a comprehensive staff briefing, accompanied by the distribution of the Participant Information Sheet (PIS); it is important to note that participation was voluntary. Surveys were conducted post-implementation among staff members who received training on the utilisation of the digital application and associated workflow. The questionnaire, developed for this purpose, was disseminated through the online survey tool JISC (Joint Information Systems Committee) over a two-week period. Consent was obtained at the outset of the questionnaire, allowing participants the option to withdraw from the project by closing the questionnaire without submitting their responses. Staff who took part within the service worked across eight locations within the service from November 2019. These locations encompassed a mix of urban facilities and smaller local units, each differing in staff numbers, demographics, and clinical throughput.

Data collected was fully anonymised during the data collection process, exported into IBM SPSS Statistics, and subsequently cleaned and coded. Descriptive analysis was conducted, treating open-ended questions as qualitative data, with responses coded thematically and cross-verified by a second researcher. The survey questions and the subsequent evaluation of the implementation of this new technology application were grounded in and applied within the framework of the Unified Theory of Acceptance and Use of Technology (UTAUT).[15]

Results

The overall response rate to the survey within this service was 28% (14/50). Table 1 demonstrates the demographics and job specifics of the participants. Fig. 1 illustrates how participants responded to several statements on their autonomy and skills in the workplace, overall, with a positive view.

Table 1
Demographics and job role of participant.

	n	%
Age group		
21–30 years	1	7.1
31–40 years	2	14.3
41–50 years	7	50
51–65 years	4	28.6
Length of time qualified		
0–2 years	1	7.1
2–5 years	2	14.3
Over 10 years	11	78.6
Involved in training new staff		
No	8	61.5
Yes[a]	5	38.5
In a specific training role		
No	13	92.9
Yes	1	7.1
Number of hours per week contracted		
Up to 15 h	2	14.3
15–29 h	5	35.7
29 or more hours	7	50
Total	**14**	**100**

[a] Total n = 13.

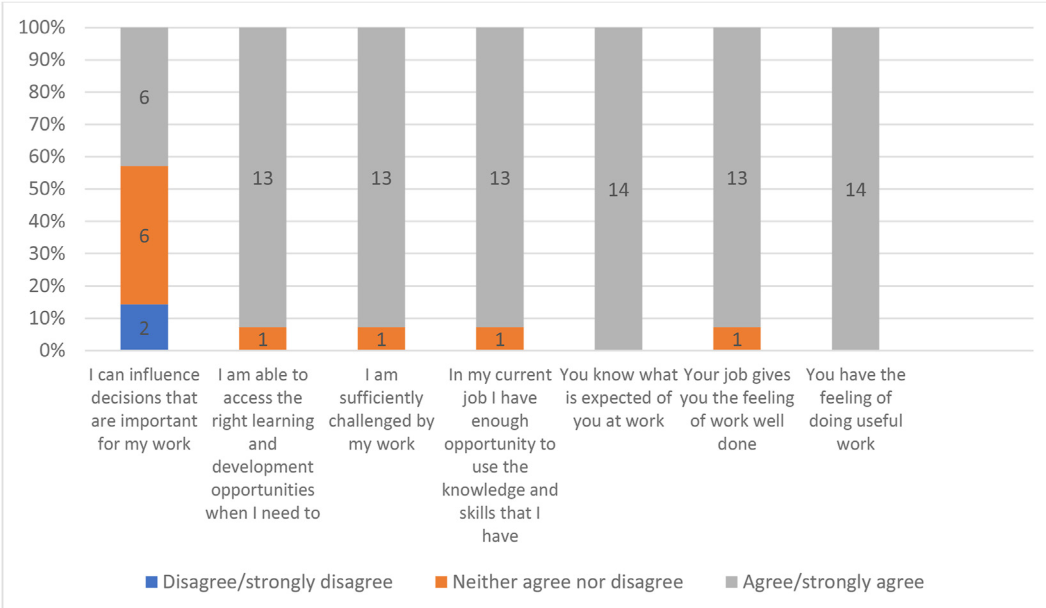

Figure 1. Autonomy and use of skills in the workplace.

Table 2
Factors important in feedback of image quality to mammographers.

Feedback	N	%
How my metrics relate to other team members in the service	2	14.3
My individual technical repeat and recall data		
My own individual PGMI data	2	14.3
All of the above	10	71.4
Other		
Total	**14**	**100**

Table 3
Feedback of image quality given by Volpara.

Feedback	N	%
How my metrics relate to other team members in the service	1	7.7
My individual technical repeat and recall data		
My own individual PGMI data	1	7.7
All the above	11	84.6
Other		
Total	**13**	**100**

All respondents were currently using technology/digital process to assist in image appraisal/assessment and nearly two thirds (64.3%, n = 9) reported this process was fully digital, with a further 28.6% (n = 4) working with semi-manual processes. One individual described:

"Refer to digital and double check agreement manually with a random selection of examinations." P7, qualified over 10 years.

Over half (53.8%, n = 7) of respondents were using fully digital processes whilst undertaking audits and dose recording, with speed and automation being a useful aspect of the system. As dose is numerically recorded with no subjective aspects it is an accurate data point in the system for useful extraction:

"The speed of reporting is useful with limited time from clinic hours." P7, qualified over 10 years.

Ten individuals (71.4%) felt that all the options "how my metrics relate to other team members in the service", "my individual technical repeat and recall data" and, "my own individual PGMI data" were important to them when assessing their image quality (Table 2). This was then reflected in the experience of the actual feedback received from the VA data (n = 11, 84.6%; Table 3).

Over three quarters (n = 11, 78.6%) understood the reasons behind why VA was installed (Fig. 2); with n = 12, 85.7% either strongly agreed/agreed or neither agreed nor disagreed with the statements "I can see the benefit to having Volpara within our service", "Volpara feedback is an effective way to support the development of my practice" and "Since I have been given feedback about my metrics using Volpara I feel that I can react to any issues I have quicker than previously".

Nearly all the participants (92.8%, n = 13) felt satisfied or very satisfied with the current VA feedback mechanism on their performance. Over three quarters (78.6%, n = 11) rated the extent they generally felt that the addition of VA metrics could support and enhance their work practices highly:

"A glance at my overall improvement curve as I am very new, also helpful videos on how to address my problem areas." P14, qualified for 0–2 years.

The feedback also helped other mammographers to improve confidence in their own skills:

"Seeing where I lie against other techs' averages as it instils confidence in my work." P4, qualified over 10 years.

Others felt the feedback enabled a useful comparison to others in the service, whilst some appreciated the ability for an overview of their work:

"Comparing to others in our service." P6, qualified over 10 years

Mammographers reported a variety of qualities of VA when undertaking image appraisal; enabling members of staff to improve their technique, image quality and knowledge:

"I like Volpara as an easy to use, non-biased way of critiquing my images, and I also like manual as it allows for reasons why my

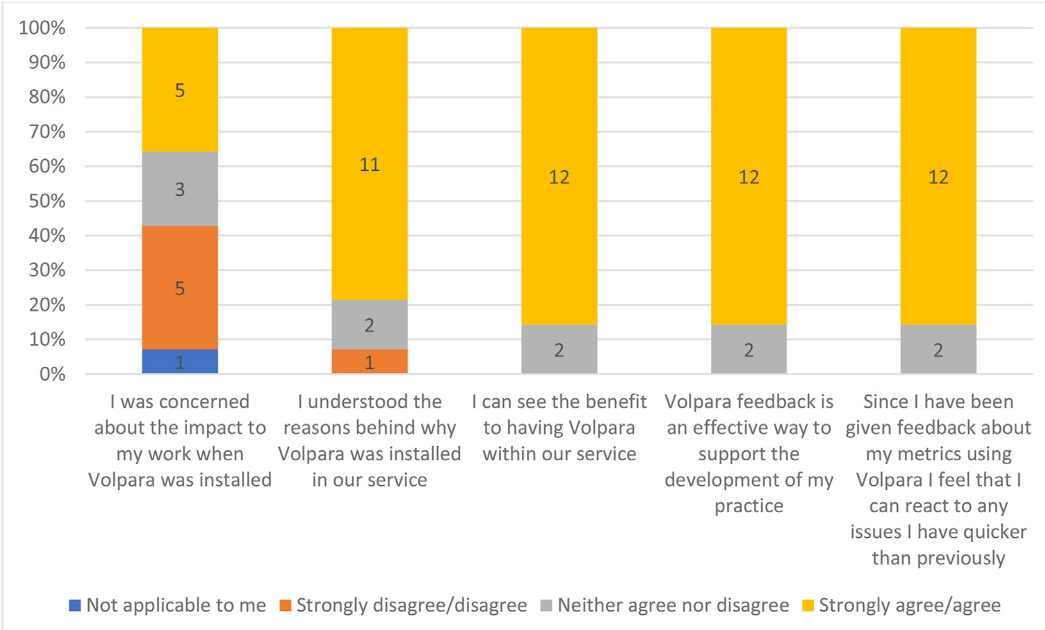

Figure 2. Feelings about using Volpara Enterprise technology during breast screening.

images are not perfect (e.g., surgical changes).” P14, qualified 0–2 years.

This mammographer liked using VA but noted that the context of critiquing images manually alongside digital processes as important, as it gave an idea of reasons why the image may not be fully accurate. Others explained how using VA enables quick feedback, highlighting areas where changes can be made:

> “It directs you specifically to areas of where you can improve image quality.” P5, qualified over 10 years.

Other ways in which VA was viewed useful was that it allowed for consistency, accuracy and comparison of image taking, and saved time previously spent on manual checking:

> “That all positioning data is collected and appraised automatically, saving time previously spent manually assessing images.” P4, qualified over 10 years

Mammographers felt that using digital processes promoted a level of consistency across the service, where all images are critiqued using the same standards and that the data provide a clear indicator of performance:

> “It critiques all staff images on the same basis so there is no bias involved.” P11, qualified over 10 years.

Very few challenges faced by services using VA were identified with reported issues around the context and nuances of the situation and the client, body habitus, previous surgery, mobility and positioning difficulties not accounted for and therefore, the context not immediately clear to those analysing the data:

> “It can be challenging to see imaging assessments that don’t take into account positioning difficulties, surgical changes, jigsaw-type imaging in large breasts, etc.” P4, qualified over 10 years.

In a large practice, there were concerns about being able to train all staff to use the software and there was apprehension around receiving or giving feedback on image appraisals:

> “Staff might sometimes be sensitive to feedback. Difficult to those that have to deliver it.” P5, qualified over 10 years.

Whilst some participants praised the time-saving qualities of using VA, others felt that finding time to cross check and review images challenging. Some reported a lack of trust in the digital system:

> “Not all appraisals appear accurate, i.e., software saying nipple is not in profile when it clearly is.” P4, qualified over 10 years.

Alongside potential challenges around trusting the image appraisals, it was felt by one mammographer that it can lead to feelings of lack of confidence in ability and some anxiety around skills:

> “It can create some anxiety around your skills as a mammographer, particularly as your manager can review your score.” P9, qualified 2–5 years.

Using VA technology was considered important in highlighting both areas for improvement and strengths in the breast services. Identifying areas for improvement and professional development at service level were considered a key advantage:

> “It can highlight areas that need improvement to target areas for professional development training sessions” P9, qualified 2–5 years.

It was also noted that the appraisal data can be used within the service as educational material and an opportunity to gather data for marketing:

“Can give the marketing people for your service extra data to promote the service.” P5, qualified over 10 years.

Discussion

The main aim of this study was to explore factors involved in the roll out of a digital application within a breast imaging service; a case-based approach was employed. The evaluation of UTAUT predictors was incorporated to underpin the primary goal of this research. The ensuing discussion will systematically address each of the four UTAUT predictors, with the intention of offering insights to facilitate future implementations of such technology within a service.

Performance expectancy

The evaluation of mammographic image quality is susceptible to observer variability,[18,21] as detailed manual image classification is both time-consuming and known to pose challenges to validity, being inherently subjective[21,22].[23] Manual assessments often involve the use of subjective terms such as “appropriate,” leading to interpretational variability, and research indicates significant disparities in agreement regarding manual image assessment.[22–26]

Agreement in image evaluation ratings between radiographers and digital systems varies depending on the specific parameter of image quality under consideration. While it is acknowledged that automatic systems may encounter challenges in recognising anatomical areas in certain cases, they are increasingly utilised in practices to facilitate feedback mechanisms. Studies indicate that mammography staff may exhibit greater alignment in decision-making with each other compared to alignment with artificial intelligent (AI) processes, highlighting a discernible difference between human and AI assessments.[24] Nonetheless, the adoption of automatic systems has demonstrated a distinct advantage in reducing the time burden associated with manual assessments.[24] Given the inherent subjectivity and time-intensive nature of manual image assessment, its demonstrated advantages include facilitating reflection on technique, potentially leading to an enhanced emphasis on optimal technique. Consequently, for users to anticipate improved job performance, it is imperative that any installed digital system supports and/or enhances the process.

Research suggests that a fully automated AI or digitised system can offer the advantage of instantaneous actionable positioning feedback during patient interactions,[25,26] it is noteworthy that the VA software currently lacks an automatic connection between patient habitus and the image, and, therefore, the replacement of human image evaluation with an automatic image evaluation was not explored in our study. Most of participants (n = 12, 85.7%) either strongly agreed or agreed that they could perceive the benefits of having VA within their service. Additionally, participants (n = 12, 85.7%) recognised the potential of the feedback mechanism to support their practice and reported positive outcomes since implementation. In the context of performance expectancy, users concurred that the system would indeed assist them in their professional responsibilities of their roles which could potential influence improvements to the patient pathway.

Waade and colleagues in 2021[24] emphasised the significance of educating radiographers to comprehend and place trust in automated tools, supporting the need for transparency regarding functionality to establish trust in the system. Consistent themes emerging from the results of our study revolved around the mammographic positioning appraisal tool VA. The study acknowledged the value of VA, particularly its capacity to offer prompt assessments of image quality without human bias. However, concerns about placing trust in VA as a reliable assessment tool were raised due to perceived inaccuracies. Some participants expressed reliance on manual assessment of mammogram positioning in conjunction with the use of VA. Notably, there was a perceived inadequacy of VA in critiquing mammograms post breast surgery. Prior studies evaluating AI automated imaging critique excluded participants post-breast conservation, indicating a common challenge for such digitised systems. This supports the argument for segregating screening mammograms from post-surgical mammograms, potentially fostering increased trust among mammographers.

The time-saving advantage of VA, as evident in the responses of this study, aligns with broader findings in the literature.[24,25] However, some respondents expressed a lack of trust in the digital VA system, attributing it to the absence of contextual information, demonstrating the importance of comprehensive training for the successful integration of a new system. Concerns were voiced regarding the feasibility of training all staff, with apprehension about potential challenges in giving or receiving feedback on image appraisals, impacting staff relations and morale.

Nevertheless, a majority of participants (92.8%, n = 13) reported feeling satisfied or very satisfied with the VA feedback mechanism on their performance. Furthermore, 78.6% (n = 11) of respondents indicated that they perceived the addition of VA metrics as supportive and enhancing of their work practices. Additionally, VA was recognised as valuable for identifying areas for improvement and professional development at a service level, extending beyond individual considerations. In conclusion, regarding performance expectancy, respondents believe that the system currently aids them in their job and can anticipate future benefits that will enhance the end user experience.

Effort expectancy

The UTAUT model for technology adoption acknowledges the significance of gender as a crucial factor in adopting technology. Gender is a key predictor in the acceptance of new technology[27] the influence of gender varies depending on the specific technology application and it is recognised that, as individuals age, the disparities in computer efficacy based on gender diminish; recognising that this may be due to heightened exposure to computer technologies earlier[27,28].[29] Considering the predominantly female workforce within mammography services, it would seem important to recognise any potential variations in attitudes and confidence during the implementation and development of digital skills. Despite technological advancements over the past two decades, women, in general, have exhibited a somewhat less favourable attitude towards technology.[27,28] Over time, positive attitudes toward technology use have improved for all genders,[29] which could demonstrate the importance of training to support staff in acquiring necessary skills. It is noteworthy that these previous analyses, although not conducted by a group of professionals in a technical field, acknowledge that the perception and development of digital skills can contribute to the successful adoption of technologies.

Hardy and Harvey (2020)[8] demonstrated that technological expansion within medical imaging is not a new phenomenon, with changes in imaging technology and computerisation yielding substantial benefits in patient care. Our study did not identify biases or concerns in attitudes towards technology implementation, however, it is noted that when any new system is incorporated its ‘ease of use’ would seem essential to support those changes to work practices and culture required to upgrade skills, and support technology adaptation by 2024.[30] Ultimately a system could be considered ‘easy to use’ if the correct training and support is implemented.

Social influence

During the implementation of any technology, it is crucial that it proves effective within the peer group, and that the peer group recognises its value. A majority of individuals from this study (71.4%) acknowledged the significance of the feedback provided by VA, appreciating its utility in facilitating comparisons with others in the service. Some individuals also valued the ability to gain an overview of their work, fostering consistency across the service by applying the same standards to all image critiques. However, it is important to note that feedback from the system is initially numerical and lacks context unless staff proactively review individual cases. This potential lack of context may result in a diminished trust and perceived value by staff if they consider the numerical data to be non-representative or inaccurate.

There is a potential assumption that more experienced mammographers may undertake more complex imaging, leading to a lower system score despite being technically capable. This could result in a false deflation of their individual feedback data. Additionally, this poses a related risk of bias, as mammographers may only check individual cases when the scores are lower. Any errors are likely to occur in both directions, but staff may only express a lack of trust in the system when feedback is negative.

Hence, in considering social influence, it is crucial that feedback mechanisms provided to staff and the team are detailed and easily understandable. The feedback afforded respondents the opportunity to observe overall improvement and areas for enhancement, contributing to increased confidence in their individual skills. Additionally, it facilitated valuable comparisons with other staff members in the service. From a social influence perspective, mammographers perceived this positively and believed their peers should also utilise the system. Applying these insights to future implementations of similar technology within a service, it seems evident from this case study that staff awareness regarding how such a system can support skill improvement and boost confidence is essential.

Facilitating conditions

The perception of an individual regarding their organisation's capacity to support the implementation of a new system is intricate and influenced by various factors. Huryk (2010)[31] delved into Lewin's change theory, that individuals tend to resist change unless they recognise existing issues with the current approach and believe in a superior alternative. Moreover, individuals undergoing change must be open to acquiring new skills and should feel secure in their learning environment, often facilitated by mentorship. One aspect involves the individual's perception of the training provided by the service during the integration of the new system or by the new system itself. It is imperative to incorporate targeted educational and developmental resources based on staff needs to support the rollout of a new digital system. This, in turn, is expected to enhance patient outcomes. A substantial majority of respondents (92.9%) agreed or strongly agreed that they were able to access the right learning and development opportunities, were sufficiently challenged by their work, and had ample opportunities to utilise their existing knowledge and skills. These findings suggest that a positive culture is in place to support workplace developments during the implementation period. The facilitating conditions seemed in place at the organisation where the study was conducted.

When considering facilitating conditions, staff well-being emerges as a crucial aspect, necessitating essential support in the workplace. Challenges or additional strains, such as the introduction of new technology or inadequate training, have the potential to induce errors and negativity among staff. In such instances, practitioners may encounter stress, anxiety, or burnout[32,33,34] all of which can adversely impact their mental and physical health. Recognising warning signs and cultivating strategies to tolerate and alleviate these feelings is vital to mitigate the risk of illness and errors, both of which can arise when practitioners experience stress, anxiety, or burnout. Within this case study, alongside potential challenges related to trusting image appraisals, two mammographers expressed concerns that it could lead to feelings of reduced confidence in their abilities and anxiety about their skills.

Applying these insights to future implementations of such technology within a service, it becomes evident from this case study that training and well-being are factors to consider during the rollout process.

Study limitations

Conducted in a breast unit in Australia, this case study approach delves into key discussion areas and serves as the initial insight into the implementation of a digital application. It could be regarded as a foundational reference for future evaluations of digital applications. The case study features a small sample size and a low response rate. While caution is warranted in making assumptions based on this data, the results (or their absence) can be utilised to recognise potential challenges for future installations of new technology applications and processes within a service.

A notable consideration is that non-response might signify resistance to the introduction of the system. The selective non-response could introduce bias, offering further insights into the importance of stakeholder inclusion at all stages of technology introduction. It could be supposed that more motivated staff and those with higher digital fluency are more likely to respond to the questionnaire, potentially biasing the data further. Understanding whether the lack of response is attributed to a lack of motivation for the survey or engagement with the technology is a crucial aspect to consider when evaluating technology implementation within a service.

Conclusions

The incorporation of digitised technology into a service is evidently met with challenges. Although there is potential value in utelising automated feedback for workflow improvement and patient services, it would seem imperative to provide targeted and developmental resources for educational development and staff well-being during the implementation phase. Research around digital fluency within the radiography profession requires further consideration. Under-utilisation or resistance to new technologies may result in missed opportunities to enhance patient experiences and care outcomes. Therefore, continued engagement and the encouragement of user feedback are crucial to demonstrate the future acceptance of these technologies in clinical settings.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT3.5 in order to support language and readability in certain paragraphs. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Conflict of interest statement

None.

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