

# Adoption of Digital Health Technologies in Supported Living Services

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**Abstract:** The adoption of digital health technologies in supported living services has shown great potential to revolutionise the quality of support offered to service users who are predominantly adults with learning disabilities and mental health conditions. Despite these potential benefits, the adoption of these technologies in supported living services remains at a low level. Therefore, this study aimed to address this gap by investigating the factors influencing the adoption of digital health technologies in supported living services. The research employed a mixed-method approach, conducting a case study in two local supported living services with a sample size of six participants, three from each service. Analysis of the collected data, utilizing both descriptive statistics and thematic approaches, revealed that 83.3% of participants acknowledged widespread acceptance of digital health technologies in the services. Notably, 66.7% highlighted the prevalence of health monitoring and assistive technology devices, including blood pressure monitors, blood glucose monitors, mobility scooters, and virtual assistants. Participants attributed the positive adoption environment to facilitation factors such as enhanced funding, training initiatives, and organizational support. Furthermore, most participants emphasized the essential need for a medication reminder app, expressing a preference for an easy-to-use and user-friendly design.


## 1 INTRODUCTION

Adopting Digital Health Technologies (DHT) in adult social care services can revolutionise care delivery for residents and improve their quality of living (CQC, 2022). DHT aims to improve health and care services as well as health systems (NIHR, 2022). One crucial aspect where DHT has shown significant impact is supported living services, which accommodates and provides some level of care and support to people with learning disabilities and mental health conditions (NHS, 2021). Similarly, adopting care technology in supported living services can promote independence of the residents and reduce care packages, which would eventually result in considerable cuts in cost for the operators. As digital health technologies become more accessible, there is a growing interest in their potential to enhance the quality of care and promote overall health and wellness. However, despite the potential benefits, there are also challenges to adopting these

technologies. The National Health Service in the UK (NHS) Digital (NHS Digital, 2022) stated that digitally excluded people have higher risks of being left out of health and social care services. Consequently, there is a need for further research to understand the factors that influence the adoption of DHT in supported living services and to identify strategies for successful implementation.

Supported living housing is a service or scheme that provides individuals with disabilities, or mental health needs the opportunity to live as independently as possible in their own homes or shared living spaces with appropriate support (NHS, 2021). People who live in supported living accommodations are called service users. According to Health and Care Professional Council (HCPC) (HCPC, 2018), a service user is anyone receiving the care or support of a professional registered with HCPC. Also, supported living accommodation involves a housing service which comes along with supervised support or care. Although there is a close relationship between care homes and supported living housing, one of the

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primary differences is that supported housing aims to promote residents' independence. According to NHS (2021), supported living services suit service users who want to avoid living in residential care.

DHT refer to a range of devices and applications, such as mobile health apps, wearable devices, and telehealth systems, that use digital technology to support healthcare delivery and improve health outcomes (NIHR, 2022). Despite the digital transformation agenda suggested by the NHS, which advised all health and social care providers to adopt the use of digital platforms and technology in service delivery, the level of adoption of DHT in supported living services is still at a low level, especially in the aspect of medication management.

The purpose of this study is to explore ways that will ease the adoption of DHT in supported living services by analysing the use of DHT in supported living settings and examining the case studies to identify barriers, facilitators and impact factors. The two main research questions addressed in this study are: 1) "What are the guidelines for adopting digital health technologies in supported living services?" and 2) "How can the adoption of digital health technologies enhance the quality of care in supported living services?".

The scope of this research covers only the supported living services in Bournemouth in the UK, with specific consideration of two services used as case studies. The supported living accommodation considered for this study is the supported living housing for adults with learning disabilities and mental health diagnoses. This study focuses on adopting DHT in supported living services from the perspective of the support team, mainly the service managers and support workers.

This paper is organised into seven sections. This section presents an introduction to the problem domain and overview of the study. Section 2 presents the literature review and Section 3 provides the research methodology employed. Section 4 presents the data analysis and results. Section 5 proposes a sample system design for a medication reminder mobile application to be used in supported living services. Section 6 and Section 7 present the evaluation of the study and conclusions respectively.

## 2 LITERATURE REVIEW

### 2.1 Use of DHT in Social Care

Adopting digital health technologies has several benefits to users and the health and social care

system, which became very visible during the COVID-19 pandemic (NIHR, 2022). The use of DHT has shown evidence during the pandemic, of giving more people access to healthcare, improving health outcomes of users, and increasing the quality of health and social care system by rapid decongesting of hospitals (GOV.UK, 2022b). One of the examples of DHT adopted in the UK is telecare, e.g., the use of digital devices such as personal alarms and monitoring systems in adult social care to help majority of residents manage risk and promote safety. The use of telehealth gained wide acceptance during the COVID-19 pandemic, with the NHS launching a video consultation service using video enhanced app like Zoom to reduce the risk of infection via physical contact (Hutchings & Morris, 2022; CQC, 2022).

The remarkable growth in the use of DHT in the UK has introduced technology-enabled care (TEC), which is the harmonisation of telecare, telemedicine, m-Health, and eHealth services (NHS, 2022). The convergence of these services produces an integrated care system that will improve the quality of care delivered in health and social care. According to GOV.UK report (2022a), the digital transformation of health and social care is a priority. The report mentions that some of the transformation goals expected to be taken include providing a solid digital foundation for health and social care by ensuring that integrated care systems are digitally mature, promoting the independence of people by digitalising health and social care channels, facilitate the adoption of trusted DHT devices across the board and providing relevant regulations in places to help integrated care systems reach full adoption.

DHT has been a core part of patient management, as it has increased access to healthcare services and helped healthcare practitioners communicate better within the system (NIHR, 2022). Hutchings and Morris (2022) state that 87% of the public and 94% of clinicians favoured video consultation for scheduling health and care appointments when a digital maturity assessment was conducted in Scotland. However, despite the several benefits of DHT to the NHS, data privacy and security concerns were also raised (GOV.UK, 2022b). Subsequently, learning is one of the critical areas of using digital health solutions in NHS settings nationwide.

Another critical aspect of using DHT in the NHS is the electronic prescription service (EPS) which reduced the number of unsigned prescriptions to pharmacies in the UK (Franklin et al., 2013). The introduction of the NHS app is another beneficial digital solution launched in 2019. The NHS app has received many credits for playing a significant role

during the pandemic (Cassels, 2022). According to the 2022 data, the NHS app had over 22 million users and helped to manage over 1.1 million GP appointments and generated over 140 million vaccination passes. In addition, DHT has also been beneficial in diagnosing and managing diseases (NIHR, 2022). Also, evidence supports using DHT in older residents to enhance their mental health in areas such as fighting loneliness, promoting independence, and improving moods (Leigh et al., 2020; NIHR, 2022). However, despite this benefit, there are concerns such as low mood and fear of results from using DHT which may become barriers to their use.

Another vital area where care homes have implemented DHT is electronic health recording (EHR). Using EHR systems across the UK showed improved communications between care homes and health centres, enhanced residents' registrations, and optimised access to residents' health records (NHS 2022; Lapp et al. 2022). Another important aspect is the use of assistive technologies. Sharif et al. (2018) suggests that due to the ageing population in the UK, many senior citizens in care homes require assistive technologies to improve the quality of their lives. Assistive technologies such as adaptive keyboards and mobility aids benefit residents; and suggests that user-centred research is vital in determining a resident's choice of assistive technology. Alzheimer Society's (2015) factsheet indicates that the application of assistive technology in the care of residents with dementia can help their daily living, such as speech and cognitive functions.

## 2.2 Barriers and Challenges

DHT has been increasingly implemented in care homes to support care delivery. These technological interventions include telehealth, telemedicine, telemonitoring devices, digital recording systems and digital games for the residents' leisure among others (Shah et al., 2022). However, despite the benefits of telemedicine and telehealth application in care homes, privacy concerns and other barriers were highlighted in the literature (McGee et al. 2020). One of the main barriers to adopting DHT in supported living services is the need for digital skills and literacy among staff and service users. Cummins and Schuller (2020) suggest that a low level of digital and health literacy is a crucial barrier to adopting DHT in health and social care settings. This issue is prevalent among the elderly population in most cases. This barrier could be addressed by providing training and support for staff and service users to increase their digital skills and literacy.

In addition, funding constraints, lack of IT infrastructures, weak information governance and interoperability issues have been highlighted to be significant barriers to adopting DHT in social care settings (Lennon et al., 2017). According to Vaportzis et al. (2017), the complexity of operating most digital health devices, especially with older residents, can slow the adoption of DHT. Furthermore, ethical, data privacy and security concerns are other barriers to adopting DHT in the supported living service (Whitelaw et al., 2021). This barrier can be addressed by ensuring that DHT complies with data protection regulations and that users have clear information about how their personal information will be used.

## 2.3 Facilitators and Opportunities

Regarding the facilitators, user-friendliness and personalised design to fit into users' needs are essential ways of easing the use of digital health solutions (Whitelaw, 2021). Carrying out user research before choosing DHT is essential as this will promote the ease of adopting user-centred technologies in social care.

Additionally, Tyrell (2021) highlights improved funding as a primary facilitator because most digital health solutions patients and residents use come with a price. Therefore, proper reimbursement of clients will encourage the adoption of DHT. Similarly, Ainsworth (2021) mentions the need for accessible funds to drive the digital transformation agenda in social care and explains that NHS has set up a united tech fund as part of the Who Pays for What (WpFW) approach to fund social care players such as supported living services.

Training programmes to upskill staff and residents alike have facilitated the adoption of DHT in care settings (Whitelaw et al., 2021). Adopting strategies such as creating a robust IT infrastructure, tackling interoperability issues, establishing a practical framework for information governance can help to increase the use of DHT in social care.

# 3 RESEARCH METHODOLOGY

## 3.1 Data Collection

We adopted a case study mixed method approach in this research (Yin, 2014). In this research, we also adopted the Technology Acceptance Model (TAM) theoretical framework which models how users accept, use and adopt a technology. We employed the standard scientific research process that defines the

steps for conducting research. This study was conducted according to the ethical guidelines of Bournemouth University in the UK. Two supported living services in Bournemouth supported the study at an operational level. Informed consent was obtained from all subjects involved in the study.

### 3.2 Methods

The primary data collection for this study was done using an online questionnaire distributed to the participants from the support living houses via social media platforms and emails after obtaining approval from the participants. The online questionnaire was designed using Google Forms as it is easy to use and supports rapid analysis of responses at no cost. Correspondingly, a mixed methods questionnaire with 26 questions was designed to have open-ended questions aimed at gathering qualitative data and close-ended questions aimed at gathering quantitative data. Combining qualitative and quantitative data provides a broader and better perspective for a researcher to delve into new insights.

After obtaining approval from the relevant services, participants were provided with a link to the online questionnaire between 25<sup>th</sup> March and 10<sup>th</sup> April 2023. The questionnaire consists of questions about demographic information, the participants' perceptions and experiences with DHT, the impact of DHT on the quality-of-care delivery, medication management, and the recommendation of features for the design of a medication reminder app.

The convenience/purposive sampling method was chosen for its appropriateness in capturing insights from specific individuals within supported living services who have direct experience with digital health devices. Given the unique characteristics of service users in supported living services, predominantly individuals with learning disabilities and mental health issues who require some level of support from professional support workers (CQC, 2022; NHS, 2022). This targeted approach ensures that the chosen participants possess valuable insights into the impact of digital health technologies.

Table 1 shows the details about the participants' roles. Eligibility criteria is as follows: participants are above 18 years of age, they are members of the support team, and they have worked with residents that required digital support; the service must be situated in Bournemouth, the UK and the service must be regulated by the CQC (Care Quality Commission), NHS or BCP council.

Table 1: Participants' roles.

	# of participants	Role
Supported living house 1	3 staff members	Service Manager
		Team leader
		Support worker
Supported living house 2	3 staff members	Service Manager
		Social worker
		Support worker

### 3.3 Questionnaire Coding

In qualitative research, the purpose of coding is to convert qualitative data into a convenient format for analysis. A codebook is often used as an essential component of this process, where codes are assigned to each response option, and instructions are provided on handling missing data and coding open-ended responses. This study adopts a hybrid coding approach which combines the deductive and inductive coding approaches to analyse the qualitative component of the mixed method questionnaire results. The deductive codes involve coding qualitative data around the themes drawn from the literature review. The inductive coding uses themes created from the answers provided by the participants and can be used for qualitative and mixed-method research (Swain, 2018).

## 4 RESULTS

The collected data was analysed by using a hybrid approach combining statistical and thematic methods. (Swain, 2018). The quantitative data was analysed using statistical methods, while the qualitative data was analysed using the thematic approach. To simplify the analysis, the supported living services have been assigned terms, with first supported living service termed *House 1* and second one as *House 2*.

### 4.1 Quantitative Data Analysis

The quantitative data was analysed by using Google Forms' inbuilt statistical analysis tool which generates an immediate analysis of participant responses. This section presents the quantitative data provided by participants residing in House 1 and House 2. Regarding the demographic information, all six participants were over 18 years and females. Among the participants, four of them have (66.7%) more than 5 years of experience in supported living, while two participants have experience ranging from 1 to 3 years.

According to the results, four participants (66.7%) acknowledged utilising DHT in their services while the remaining two were uncertain. When questioned about the reason for implementing DHT in their respective services, participants selected the main reasons being improving efficiency, improving quality of care and increasing productivity. Figure 1 shows the presence of DHT and the motivation for using it in their respective services.

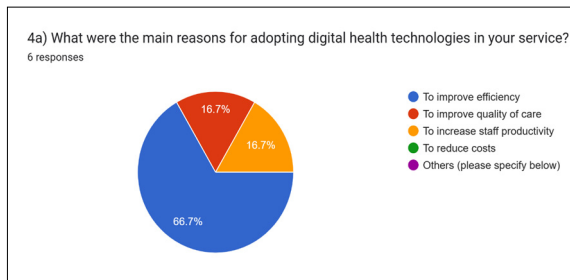


Figure 1: The reasons for adopting DHT in the services.

Regarding the technology acceptance, 5 out of 6 participants (83.3%) agreed that service users widely accept digital health technologies. This suggests that there is no resistance to technology from the residents.

After a thorough review of relevant literature, it has been established that various classes and types of DHT are being deployed in social care nationwide. To better understand this, participants were questioned about the types of DHT devices utilised in their services as indicated in Question 7 and results are shown in Figure 2.

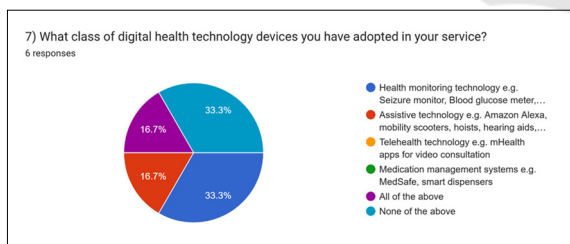


Figure 2: Classes and types of DHT in supported living services.

Regarding to the questions asking participants to share any challenges they faced while adopting DHT for their services and if they encountered difficulties using DHT to improve care delivery, 66.7% of the participants reported that they did not experience any barriers during the process, yet they agreed that certain factors have contributed to implementing DHT in their services where they listed the specific factors in the qualitative data. In terms of the quality

of care, all participants agreed that adopting DHT in their services has significantly or somehow improved the quality of care.

Participants were also asked how DHT is adopted in their services and how it is regulated. They reported that they are using NHS, CQC or council guidelines. Most of the participants agreed that guidelines were helpful and had a significant or some impact in the adoption process. Participants were asked questions related to medication administration and regarding using a medication reminder system. The answers from the participants revealed that all participants administer four or more medications daily and they do not use an app at that time. When asked about missing or forgetting the doses or medication, 5 participants reported this as a risk and may happen rarely.

Participants were asked about their opinions on the significance of medication reminder apps in supported living services. Question 25 revealed that 4 participants (66.7%) considered it important, while 2 (33.3%) believed it is very important, as depicted in Figure 3. Finally, in response to question 26, all participants agreed that they have no concerns about using medication reminder apps.

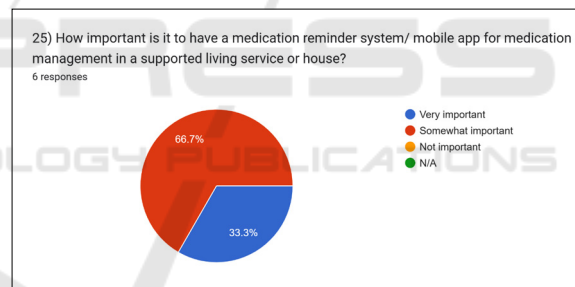


Figure 3: Level of importance of medication reminders to the services.

Quantitative data from the case study from the two supported living services has been compared to see if there is any significant difference. There was not any significant difference in the results but only a slightly high acceptance and usage of DHT in House 1.

## 4.2 Qualitative Analysis

The qualitative data gathered from the study were coded and analysed using the thematic analysis approach. After generating the initial codes and defining the themes, the qualitative data was collected from patterns and trends in the participants' responses. Then, they were arranged into themes to align with the research questions, aims and

objectives. There were 14 open-ended questions in the questionnaire from where the data were drawn.

Participants were asked about the digital health solutions currently used in their respective services and the ones they plan on adopting. Codes identified from the data helped to define the *DHT Types theme* are listed below:

- Health monitoring devices: blood pressure monitor, blood glucose monitor, etc.
- Assistive technologies: virtual voice assistants, mobility scooters, electric wheelchairs, etc.
- Health information systems: electronic health records (EHR), digital recording systems, integrated health management systems, etc.
- Healthcare applications: phone applications, online systems for residents, etc.

*Positive Impacts theme* was defined from the responses the participants gave to questions 12 and 13 when asked to state how DHT has improved the quality of care in their services and how it has benefitted them. The answers were carefully organised into codes to form the *Positive Impacts* of DHT on the quality of care as below:

- Improved quality of life of service users: improved safety and independence of service users, reduced incidents of clinical emergencies because of the effective use of health monitoring devices.
- Increased operational efficiency: promoting self-management of service users, service users can take the lead in their support plan, resulting in effective time management and cutting operating costs.
- Increased productivity: using digital health interventions ensures that workers can do so much within a considerable period.
- Effective management of data: DHT such as digital recording promote information accuracy and effective data sharing within the care and management team of service users.
- Enhanced person-centred support: the deployment of DHT ensures service users are supported according to their peculiar needs, it promotes using the right digital solution for the right person for the proper purpose.
- Improved collaborations with external partners: The participants revealed that DHT helps information sharing with relevant partners as quickly and effectively as possible.

The participant's responses to questions about the challenges experienced during previous adoption and those anticipated in future adoption (questions 9b,

14b and 19), and the personal contribution of one of the respondents in question 20b, were coded and used to form *Barriers theme*. Identified codes for the *Barriers* to DHT adoption are as follows:

- Cost of DHT implementation: some services might find the cost of implementing DHT expensive, the need for sufficient funding to purchase and maintain DHT.
- Low digital literacy among staff and service users: some staff and residents may not be familiar with the technologies.
- Resistance to change: some staff and residents may be slow in integrating new systems and may lack the motivation to use DHT.
- Data privacy and security concerns: staff and residents may have reservations about the integrity of the systems' data and information security, resulting in low motivation to use digital health devices.
- Technical challenges: organisations may lack robust information technology and software to accommodate the flawless operation of digital health solutions.

The participant's responses to questions about the facilitating factors to DHT in their respective services, the essential guidelines, and best practices for adopting DHT (questions 10b, 15 and 16) were coded and used to form *Facilitators theme*. Identified codes are as follows:

- Training for staff and service users: this involves training for technicians and workers reading the user or operating manuals of digital devices, learning how to use the equipment.
- Supportive organisational culture: entails management support, GP recommendations, and local policy.
- Gradual integration of DHT: gradually incorporating digital technology user-centred approach, teaching workers how to use it best.
- Adherence to relevant guidelines: this includes adhering to professional and manufacturer guidelines, as well as local policy, professional guidance, risk assessments, and GDPR.

The participant's responses to questions about their opinions about the guidelines and best practices for adopting DHT in supported living services (questions 15 and 16) were coded and used to form *Guidelines theme*. Identified codes are as follows:

- Training programmes for staffs and service users: ensuring staff members are trained on using DHT before and periodically after use.

- Assessment of user experience: before implementing DHT, assess the users' needs and the site's capabilities to ensure they are compatible with the technology, introducing DHT gradually with relevant staff training.
- Adherence to relevant guidelines: following guidelines, local policy, and risk assessments to ensure compliance with regulations.
- Ensure designated use of DHT: ensuring DHT are used properly and only when necessary for applicable users.
- Privacy and security compliance: Ensure compliance with GDPR guidance and relevant security procedures.

Finally, participants were asked to share their desired features for a potential medication reminder app in question 24b as part of the study's objectives. Participants' responses from these questions were organised to form the codes below for the *Application Design theme*, which were also used to develop the functional and non-functional requirements partially.

- Customisable and flexible design: the app must offer a function that enables users to enter and modify their medication information by their requirements, the app should provide users with customisation options such as personalised reminders and notifications.
- User-friendly interface: the app should be easy-to-use, straightforward, and intuitive, making it accessible to many users, the ability to create and manage user profiles, calendar view of the medication administration record (MAR).
- Responsive design: to ensure users can access their information from anywhere, the app should be designed to work effortlessly across multiple devices.
- Enhanced data security: the app should have robust security structures to secure user data such as encrypted and other data protections.

### 4.3 Discussion

There were notable findings from the patterns observed from the data analysis of the houses. The data collected from six participants who have working experience in their roles for at least one year. This ensures that they understand the support needs and support plans of the service users of their various services. Therefore, the information they provided on the questionnaire can be regarded as expert opinions.

The data analysis shows a broad acceptance of digital health in the services, and the majority (83.3%) of participants use at least one digital health

device in their services. Similarly, the result shows that the main reasons for adopting DHT in the services is to improve operational efficiency and improve the quality of care provided. The data analysis revealed that most participants know relevant guidelines and requirements for adopting DHT, and they follow recommendations from NHS, CQC or local council, which is BCP in this case. Finally, the results showed that participants are keen to use a medication reminder application and they find it important to supported living services.

## 5 AN EXAMPLE APP

Medication non-adherence is a significant problem, leading to adverse health outcomes and increased healthcare costs. Applying digital health solutions, such as medication reminder apps, can help with this problem. Mobile applications are the most common type of medication reminder software, e.g. Medisafe, Medbuddy, etc., which combines reminder functionality with features such as medication tracking and ability to communicate with healthcare professionals (Corbett et al. 2021). However, evaluations on medication apps show that the complexity of multifunctional apps can be overwhelming for some users.

In this study, a mobile medication reminder app is designed to enhance medication adherence among residents of supported living services. The app is designed using the design thinking approach which prioritises user experience in every step of the design process. The app features a user-friendly interface that enables different tasks, such as scheduling and managing medication reminders, viewing existing reminders for medication schedules, ordering, and tracking medications from the pharmacy, customising reminder tones, and accessing weekly medication adherence reports. Potential users of the system are managers, support workers and self-medicating service users. We defined three user personas accordingly. In this study, a use case diagram was utilised in modelling the major features of the app as shown in Figure 4.

We designed wireframes and an interactive prototype as they are useful in presenting the scope of the system functionality to intended users. They were designed using the proto.io cloud-based prototyping tool.

The design includes the onboarding screen, authentication screen, menu screen, and screens for setting up medication schedules, displaying reminders, tracking progress, displaying service users

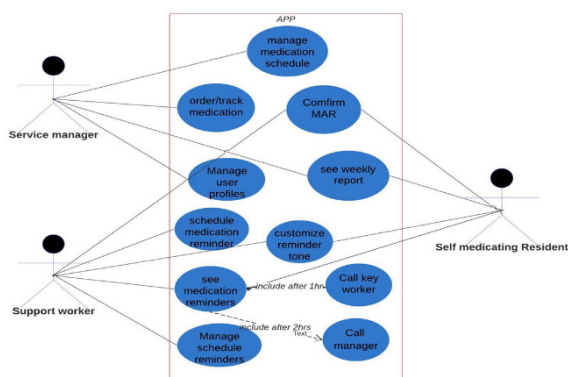


Figure 4: Use case diagram for the proposed app.

(residents) profiles, and managing user accounts. The design models are available upon request.

## 6 EVALUATION

The evaluation for this study was done by designing evaluation forms to assess the written artefact by the participants and doing a cognitive walkthrough on the interactive prototype of the medication reminder application. These steps helped validating the outcomes of this research and collecting feedback. The written artefact is designed to be a document containing the findings and recommendations to ease the adoption of DHT in supported living services. It was sent to the two houses participated in the study together with an evaluation questionnaire, which is aimed at getting the participants' observations, reservations, suggestions, and recommendations on the written solution.

The evaluation report from House 1 stated the document being useful to the service, with a special commendation on the study findings which revealed from the comparative analysis of both houses, that every house and its service users are different.

The evaluation report from House 2 indicated that they are satisfied with the written artefact presented to the management after due consultation with the project supervisor. The management confirmed that the study findings are true reflections of the reality of DHT in the service. They also agreed that digital solutions could promote independence and improve medication administration and record keeping.

We used the cognitive walk-through approach to evaluate the medication reminder app design. A usability evaluation form was designed and sent to the services with the link to the interactive prototype. The evaluation form included tasks to navigate on the prototype for different type of users and step by step

control sequence such as clicking buttons, entering data, etc. The managements of both supported living houses expressed satisfaction with the app design as they found it useful to their services according to their responses in the evaluation report.

## 7 CONCLUSIONS

The findings of this study reveal that the use of DHT and health informatics varies based on the service and the service users living in the care homes. However, this study also highlights the numerous benefits of adopting DHT, including improved quality of life for service users, enhanced operational efficiency, increased productivity of workers, and practical information management of staff and service users. Providing guidelines and best practices that supported living services could leverage can help with promoting the adoption of these technologies and tools. As a future work, a larger sample size of supported living services and participants can be employed to gather the perspectives and experiences of more services which could increase the chances of generalisation of the findings. Additionally, this study focused on the inputs and contributions of staff members only. Future research can include the service users and other relevant stakeholders to understand better the factors influencing the adoption of technology in supported living services.

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