Pharmacy Education (2023) 23(1) 362 - 367
https://doi.org/10.46542/pe.2023.231.362367

RESEARCH ARTICLE

Change in pharmacy resident familiarity, attitudes, comfort, and knowledge regarding digital health

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Keywords
Digital health
Pharmacy residency
Teaching certificate

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Abstract

Background: Digital health is a growing area of interest in healthcare, however. There is limited evidence to support this topic is being covered in pharmacy education, including postgraduate residency training programmes. This study aimed to determine if exposure to digital health topics throughout a teaching certificate programme leads to a significant change in resident familiarity, attitudes, comfort, and knowledge regarding digital health. **Methods:** The resident cohort was exposed to digital health content during a teaching certificate. Residents completed a questionnaire regarding their familiarity, attitudes, comfort, and knowledge regarding digital health at the beginning and end of the teaching certificate. Responses to each section of the questionnaire, as well as an overall score, were calculated and analysed. **Results:** Eighteen residents completed both the pre-and post-questionnaire. The median scores for familiarity and comfort increased significantly ($p < 0.0001$) after the yearlong intervention. Median scores for attitudes and knowledge did not see a significant change after intervention. **Conclusion:** After exposure to digital health in a teaching certificate programme, pharmacy residents demonstrated a significant increase in familiarity and comfort with digital health, however there was not a significant change in attitudes or knowledge.

Introduction

The COVID-19 pandemic served as a catalyst for the digital health revolution in healthcare (Keesara *et al.*, 2020; Temesgen *et al.*, 2020). With the challenges of quarantine and contact precautions, increasing numbers of healthcare providers turned to telehealth, remote patient monitoring, and the use of digital health technologies. In turn, the use of telehealth services led to lower patient no-show rates while maintaining patient satisfaction (Drerup *et al.*, 2021). This boom in the use of technology in healthcare has made it clear the need to educate the healthcare professionals of tomorrow to be prepared to use new and emerging technologies to improve patient care (Pathipati *et al.*, 2016).

The International Pharmaceutical Federation (FIP) and the American Association of Colleges of Pharmacy (AACP) have both brought attention to the need to educate pharmacy trainees in digital health (International Pharmaceutical Federation, 2021; Rooney, 2021). Despite the call to action to provide digital health education, the FIP digital health report noted that only 10% of student participants reported learning about digital health in their pharmacy curriculum (International Pharmaceutical Federation, 2021). AACP has encouraged pharmacy programmes to include digital health in their curricula (Rooney, 2021); however, they have not provided commentary on the role of digital health education in postgraduate education and training programmes.

Many pharmacists pursue residency training after completing their formal pharmacy education to prepare them to become competent in the provision of clinical pharmacy services. With digital health providing new opportunities for pharmacists to provide direct

patient care (Ng, 2018; Martin *et al*., 2018; Aungst *et al*., 2021; Park *et al*., 2022; Zhang, 2022;), it is important that residents receive digital health training. Some residency programmes offer a pharmacy informatics rotation as either a required or elective learning experience. Although informatics is a key component of the digital health spectrum, there are a wide variety of other digital health topics that residents may or may not be exposed to, including telehealth, remote patient monitoring, digital therapeutics, sensor enabled medications, wearable healthcare products, and mobile healthcare applications.

While there is limited data regarding the current status of digital health education in pharmacy schools (International Pharmaceutical Federation, 2021; Mantel-Teeuwisse *et al*., 2021), there is a paucity of information related to digital health exposure in postgraduate training. While the FIP report mostly focused on education in pharmacy curricula, there was a brief mention of the need to continue this education in postgraduate training, such as residency and fellowship (International Pharmaceutical Federation, 2021). Additionally, a perspectives piece constructed by digital health education pioneers includes residency training in a proposed digital health training structure (Aungst & Patel, 2020). The current lack of digital health in pharmacy curricula and unknown exposure to digital health in postgraduate residency training represents a knowledge gap that pharmacists may have when entering the workforce.

This study aimed to assess pharmacy residents' change in familiarity, attitudes, comfort, and knowledge of digital health after exposure to digital health topics through a Resident Teaching Certificate Program Learning Experience (RTCPLE).

Methods

Intervention

Pharmacy residents affiliated with the University of Southern California Alfred E. Mann, School of Pharmacy and Pharmaceutical Sciences, can participate in the RTCPLE. One of the main ways residents are involved in the Pharm.D. curriculum is through the weekly facilitation of a small group case conference series. Digital health was added to a select number of these cases throughout the 2021–2022 academic year as an intervention to a separate study to measure student pharmacists' familiarity, attitudes, comfort, and knowledge. The effort to add digital health into the case conference series was led by an academic pharmacy fellow with a focus on digital health education.

All residents completing the RTCPLE received introductory training on digital health in pharmacy education led by the academic pharmacy fellow during one of their weekly teaching seminars. The seminar consisted of a 30-minute pre-recorded lecture and a 50-minute synchronous activity. The fellow identified a total of nine resident created cases in the case conference series that would be tasked with including a digital health topic. After deciding on the format and content of their case, the residents worked with the fellow to identify a digital health topic to integrate into a portion of the case. Residents were instructed by the fellow to include one learning objective and at least one pre-work assignment for their case related to the digital health topic. The residents who created these cases then presented their materials to the complete group of resident facilitators during a case conference review session the week prior to the student session. During the case conference sessions, residents facilitated a small group of nine to fourteen students to discuss the digital health topic as it was relevant to the case. Postgraduate year one (PGY1) residents facilitate a different small group each semester of the academic year, while postgraduate year two (PGY2) residents facilitate one small group over one semester. Digital health topics discussed included continuous glucose monitoring systems, mobile health applications, sensor enabled medication devices, telehealth, and electronic health records. Residents also facilitated a population health case that focused on utilising digital health to improve population health outcomes.

Study participants

All residents completing a PGY1 or PGY2 programme at USC during the 2021–2022 residency year were recruited to participate in the study. Participation in the study was voluntary and had no impact on completing the RTCPLE. Residents provided consent to participate in the study before starting the electronic survey per the protocol approved by the Institutional Review Board.

Study tool

The study team developed an original questionnaire, the Digital Health-Familiarity, Attitudes, Comfort, and Knowledge Scale (DH-FACKS), for a different study involving student pharmacists. This questionnaire was modified slightly for use with residents. The DH-FACKS for residents consists of 25 questions organised into five distinct sections. The questionnaire starts with two general questions with residents rating their overall knowledge and comfort regarding digital health on a scale of zero (no knowledge) to ten (expert knowledge).

Next, residents choose their level of agreeance with seven statements about their attitudes toward digital health and digital health education. Answer choices were scored as follows: strongly agree (five points), somewhat agree (four points), neither agree nor disagree (three points), somewhat disagree (two points), or strongly disagree (one point), with the exception of one negative question where the scoring was reversed. A total attitudes score was calculated by adding the scores from the six individual questions, which could range from four to 35 points. For the familiarity section, residents were asked to select all digital health technologies they were familiar with from a list of ten healthcare technologies. They were then asked to select their level of familiarity with four specific digital health topics: wearable health technology, health and wellness applications for smart devices, digital therapeutics, and telehealth. Answer choices were scored as follows: very familiar (five points), somewhat familiar (four points), neither familiar nor unfamiliar (three points), somewhat unfamiliar (two points), or very unfamiliar (one point).

Scores from all four questions were combined into a section total that could range from four to 20. Next, residents were asked to rate their comfort with teaching or counselling a patient on the same four digital health topics presented in the familiarity section on a scale ranging from very comfortable to very uncomfortable. Scoring for the comfort section was similar to the familiarity section. Knowledge was assessed by asking six multiple choice questions created by the study team. One multiple choice question was discarded as the study team agreed that the topic was too subjective and was not covered in enough detail to be included in the final score.

Residents were asked to select the best answer from four answer choices regarding the following topics: general digital health, wearable health technology, telehealth, smart medications, and the difference between mobile health apps and digital therapeutics. The resident received a score of four points if they selected the best answer, two points for selecting a partially correct answer choice, and zero points if an incorrect answer choice was selected. The section score could range from two to 20. Each individual question was coded and scored, and a total score was calculated for each section: familiarity, attitudes, comfort, and knowledge.

The DH-FACKS questionnaire was housed in Qualtrics and distributed to residents via an e-mail link unique to each participant. Pre-survey data was gathered from the resident baseline survey conducted at the beginning of the RTCPLE, and post-survey data was gathered at the end of the teaching certificate programme.

Statistical analysis

The paired pre- and post-survey scores were compared to determine any statistical changes in learner scores for familiarity, attitudes, comfort, and knowledge of digital health after integrating specific digital health topics into the yearlong course using the Wilcoxon Signed Sum Test. A *p*-value of less than 0.05 was considered statistically significant. All analyses were conducted using SAS version 9.4 (Cary, NC). For each of the Likert Scale questions, responses were to be consolidated into two categories ("*positive*" and "*negative/neutral*" to run tests of agreeance pre- and post-intervention; however, due to the small sample size and unequal skew of answer choices, this analysis was not included.

Results

The pre-and post-DH-FACKS were disseminated to 34 residents, with a total of 18 residents who completed both the pre-and post-survey (completion rate of 53%). When asked to rank their overall knowledge of digital health on a scale of zero (no knowledge) to ten (expert knowledge), the median resident response increased from six (IQR 4-7) pre-intervention to seven (IQR 5.5-7.5) post-intervention ($p < 0.001$). The mean resident response regarding their overall comfort with using digital health in practice, using the same zero to ten scale, increased from five (IQR 3.5-7) pre-intervention to seven (IQR 5.5-7) post-intervention ($p = 0.001$). The mean composite score for the familiarity and comfort sections of the DH-FACKS saw a significant increase post-intervention, with no significant change in the attitudes or knowledge sections (Table I).

When asked to select all digital health tools they were familiar with out of a list of ten, the median number of residents selected increased from 3.5 (IQR 3-5) to six (IQR 4-7) after the intervention ($p = 0.004$). Of the ten tools, only one, smart pills, demonstrated a significantly increased rate of being selected by residents after the intervention. When asked to rate their level of comfort and familiarity with four specific tools (wearable health technology, mobile health and wellness applications, digital therapeutics, and telehealth), there was a significant increase in scores for familiarity with digital therapeutics and telehealth and a significant increase in scores for comfort with wearable health technology and telehealth (Tables II and III). The other tools saw a trend toward increased scores; however, these results were not statistically significant.

Table I: DH-FACKS category scores pre-/post-intervention

	Median pre-score (IQR)	Median post-score (IQR)	Median difference (IQR)	*p*-value†
Familiarity	13.5 (12-15)	16 (15-17)	2 (1-3)	<0.0001
Attitudes	24 (20-25)	22.5 (20-24)	-1 (-4-1)	0.27
Comfort	12.5 (10-14)	15.5 (13-16)	2.5 (1-4)	0.001
Knowledge	11 (10-14)	14 (12-18)	2 (-2-6)	0.05

†*P*-values are calculated from Wilcoxon Signed Sum Test; Statistically significant at *p*-value < 0.05

Table II: Familiarity with specific digital health tools

	Median pre-score (IQR)	Median post-score (IQR)	Median difference (IQR)	*p*-value†
Wearable health technology	4 (4-4)	4 (4-5)	0 (0-1)	0.27
Mobile health and wellness apps	4 (3-4)	4 (4-4)	0 (0-1)	0.12
Digital therapeutics	2 (1-2)	3 (2-4)	1 (0-2)	0.0002
Telehealth	4.5 (4-5)	5 (5-5)	0.5 (0-1)	0.004

†*P*-values are calculated from Wilcoxon Signed Sum Test; Statistically significant at *p*-value < 0.05

Table III: Comfort with specific digital health tools

	Median pre-score (IQR)	Median post-score (IQR)	Median difference (IQR)	*p*-value†
Wearable health technology	4 (2-4)	4 (4-5)	1 (0-1)	0.02
Mobile health and wellness apps	3 (2-4)	4 (3-4)	1 (0-1)	0.08
Digital therapeutics	2 (1-3)	2.5 (2-4)	0.5 (0-1)	0.06
Telehealth	4 (4-5)	5 (4-5)	1 (0-1)	0.01

†*P*-values are calculated from Wilcoxon Signed Sum Test; Statistically significant at *p*-value < 0.05

Two questions in the attitudes section showed a significant score change (Table IV). The score for the statement "*I think digital health is an important aspect of patient care*" saw a significant increase, while the statement "*I would like to learn more about digital health*" saw a significant decrease in score. None of the five knowledge-based questions significantly changed resident scores (Table V).

Table IV: Resident attitudes toward digital health (DH)

	Mean pre-score (SD)	Mean post-score (SD)	Mean difference (SD)	*p*-value†
DH is an important aspect of patient care	4 (4-4)	4.5 (4-5)	0 (0-1)	0.03
In my specific clinical setting, DH is an important aspect of patient care	4 (3-5)	4 (2-4)	-0.5 (-1-0)	0.29
My school of pharmacy curriculum prepared me to understand the concepts of DH	2.5 (2-4)	3 (2-4)	0 (0-1)	0.13
I do NOT think DH should be a required element of pharmacy curriculums	4 (3-4)	3.5 (3-4)	0 (-1-0)	0.14
I do NOT think DH should be included in postgraduate pharmacy training	4(3-4)	3.5 (3-4)	0 (-1-0)	0.22
I would like to learn more about DH	5 (4-5)	4 (3-5)	-1 (-1-0)	0.01

†*P*-values are calculated from Wilcoxon Signed Sum Test; Statistically significant at *p*-value < 0.05

Table V: Knowledge questions by subject matter

	Median pre-score (IQR)	Median post-score (IQR)	Median difference (IQR)	*p*-value[†]
General digital health	4 (4-4)	4 (4-4)	0 (0-0)	0.63
Wearable health technology	4 (4-4)	4 (4-4)	0 (0-0)	1.0
Telehealth	2 (2-2)	2 (2-2)	0 (0-0)	0.13
Smart pills	0 (0-4)	4 (0-4)	0 (0-4)	0.29
Digital therapeutics vs mobile health applications	0 (0-4)	4 (0-4)	0 (0-4)	0.51

[†]*P*-values are calculated from Wilcoxon Signed Sum Test; Statistically significant at *p*-value < 0.05

Discussion

Results from this study showed that while integrating digital health into a residency teaching programme increased resident familiarity and comfort with digital health, it did not significantly change attitudes or knowledge. While overall scores in comfort and familiarity showed a significant increase, when broken down by how the residents rated each of the four specific tools, there was only a significant increase in familiarity scores with digital therapeutics and telehealth and a significant increase in comfort scores with wearable health technology and telehealth. While all of the specific topics were presented to the residents throughout the teaching seminar, the most common topic used in the student cases was mobile health applications, so it was interesting that this tool did not demonstrate a significant change in comfort or familiarity score despite being presented to the residents more often than the other tools.

An unexpected result of the study was that the overall attitude score decreased after the intervention, although this result was not statistically significant. Two negatively worded questions were included in the attitudes section, which could have led to potential misinterpretation of the questions. One individual attitude question, "*I would like to learn more about digital health*", saw a significant decrease in score post-intervention. It is unclear if the drop in score for this question indicates residents had a decrease in interest in the subject matter or if they felt that they had gained enough education over the year that they no longer felt they needed additional education. Despite the trend toward a decrease in attitudes in the post-survey data, the composite attitudes score was high in both the pre- and post-survey, showing that overall, residents had positive attitudes regarding digital health.

The results for the knowledge portion of the DH-FACKS were also unexpected, as there was not a significant increase in knowledge scores. This finding is interesting, considering residents self-reported scores for comfort and familiarity increased for some of the individual tools; however, that did not align with an increase in overall knowledge scores or scores for the respective tools. With two of the knowledge-based questions regarding overall digital health and wearable health technology, the scores were relatively high to start with. However, for the remaining three topics, which had lower pre-scores, while there was a trend toward improved scores, there was no significant change despite coverage of these topics throughout the RTCPLE. These topics could be targets for more focused digital health education in future cohorts.

One of the limitations of this study was that not all residents completed both the pre-and post-surveys. In order to utilise matched data, the study team only included participants who responded to both surveys, which reduced the sample size. Due to the large size of the residency class, there was still a sizeable number of resident responses analysed for a single site study. Another limitation was that not all cases the residents created included digital health; therefore, not all residents had the same level of engagement with digital health topics during the RTCPLE. The residents with a digital health portion spent additional time researching health technologies related to their case and designing instructional materials. While the remainder of the residency class was exposed to the digital health topic while leading their small group discussion, their level of understanding of the topic was likely different from the resident who developed the case. The level of resident involvement regarding digital health in the RTCPLE was not queried in the DH-FACKS, so the study team could not determine if there were significant differences between residents who developed a digital health case and those who did not. Finding a way to get all residents involved on a similar level and stratifying the resident's level of involvement with digital health throughout the RTCPLE are areas worth exploring in further projects and studies.

The study was also limited by only being able to ensure the introduction of digital health topics in the RTCPLE and not at resident clinical sites. Due to the heterogeneous nature of all the residency programmes

and clinical sites affiliated with the RTCPLE, the authors could not target hands-on clinical exposure to digital health as an intervention for this study. This is a very important area for residents to gain practice in and an area that should continue to be explored. Lack of digital health exposure in their practice site could also be a contributing factor to why scores for the attitudes section of the questionnaire did not increase. However, as the RTCPLE is the only time all residents are all together consistently, this starting point for the introduction of digital health topics was most feasible for the current study. Despite the study's limitations, the results provide guidance on further efforts to teach residents digital health concepts.

Conclusion

The inclusion of digital health in a resident teaching certificate programme led to residents reporting increased familiarity and comfort with digital health; however, there was no significant change in attitudes or knowledge. While exposure to healthcare technologies in an academic setting may serve as a starting point for resident education on these topics, residents will likely need additional training and exposure to these technologies to lead to meaningful changes in knowledge. For residencies associated with a Pharm.D. programme, there is the opportunity to enact layered learning with digital health where faculty, residents, and students all benefit from an expanded knowledge of the subject. Residency programmes may also wish to consider how to best expose their residents to real life experiences with digital health in their clinical practice sites for improved knowledge of the subject matter.

Conflict of interest

The study team has no conflicts of interest to disclose.

Source of funding

The authors did not receive any funding.

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