

2019

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Recommended Citation

Chanane, Nawal; Mirza, Farhaan; and Naeem, M. Asif, "Insights of Medication Adherence Management: A Qualitative Study with Healthcare Professionals and Technology Designers" (2019). *ACIS 2019 Proceedings*. 74.

<https://aisel.aisnet.org/acis2019/74>

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Insights of Medication Adherence Management: A Qualitative Study with Healthcare Professionals and Technology Designers

Full Paper

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Abstract

Poor Medication Adherence (MA) remains a major challenge to ensuring good patient health. This qualitative study examines health professionals' and health technology designers' insights for improving this problem using mHealth. We interviewed twenty-three New Zealand health professionals and analysed the interviews using content analysis. In this paper, we discuss the four main themes that emerged from our analysis: 1) patient characteristics, 2) collaboration among members of the health team, 3) medication impact including effectiveness and side effects 4) technology acceptance. We present a conceptual model to visually summarise MA issues from healthcare professionals' and technology designers' perspective.

Keywords: Medication adherence, medication non-adherence, medication management, mHealth, medication compliance

1 INTRODUCTION

Medication adherence (MA) refers to the timely intake of medication by a patient as prescribed by a healthcare provider (Lüscher and Vetter 2005). World Health Organisation (WHO) considers MA a priority global problem because failure on the part of patients to take medications as prescribed leads to out-of-control epidemics that not only affect the individual patient but also disrupt the entire healthcare system (Dekoekkoek et al. 2015). Although technology has contributed immensely to the development of healthcare systems worldwide, MA remains an unsolved problem (McDaniel and Einstein 2016). A significant barrier to effective medical treatment is patients' failure to adhere to physicians' recommendations. When a healthcare provider prescribes a medication to a patient, it is uncertain whether the patient will be cured. According to Kvarnstrom et al. (2018), healthcare professionals are the primary contributors to improving a patient's health. mHealth is possibly a strategy that can be recommended to non-adherent patients by healthcare professionals or pharmacists when the said professionals incorporate it into their practice, which is not the case in New Zealand's healthcare system.

The present study aims to explore MA from the perspectives of healthcare professionals and health technology designers. The contributions of this study are as follows:

- It captures healthcare professionals' understanding of the multifaceted dilemma of MA.
- It provides insights on how mHealth could be used to improve collaboration among the members of healthcare delivery teams and the patient.

The remainder of this paper is organized as follows. Section 2 presents related work. In Section 3, we describe the data-collection methodology and analysis techniques used in this study. Then, in Section 4, we explain and discuss our findings and present the output of the analysis conducted in this study in the form of a conceptual model. Finally, in Section 5, we describe the strengths and limitations of this study, present a few concluding remarks, and chalk out an outline for future work.

2 RELATED WORK

For more than four decades, researchers presented techniques to improve MA which consequently had significant benefits on patients with long-term illness (Patton 2017). Most of these techniques used individual reports of medication taking, wearable sensors, real-time electronic monitoring, pharmacy refills, text messaging, and mobile apps (Badawy et al. 2017).

2.1 Existing Issues of Medication Adherence

Studies related to MA provide reasons for non-adherence in order to find solutions (Elliott 2013). An extended view that takes into account interactions between the patient and the healthcare provider and between the patient and the healthcare system will have the ultimate effect on improving adherence (Osterberg et al. 2005). Previous studies on MA categorised reasons for non-adherence into five main factors: Healthcare system/team factors, which include the source of medications, provider communication and access to care. The patient-related factors: which include age and gender. The therapy-related factors: include polypharmacy, side effects, duration of therapy, frequency of changes and ineffective therapy. The condition-related factors represent the current health status. The social and economic factors; covers the cultural side, the cost of medication and health literacy (Osterberg et al. 2005). In 2015, almost the same main reasons for non-adherence introduced by Lam and Fresco (2015) when conducting their study on MA measures. They included direct measures, like pill count, electronic medication packaging devices and indirect measures, like clinician assessments and self-reports. It was concluded that a multi-measure approach seems to be the best solution. Gajria et al. (2014) report on the discontinuation of medication based on age range. The reasons differed slightly between each age group; for example, parents/caregiver's decision, poor adherence, school factors and misdiagnosis were more likely to be factors for children rather than for adults.

Moreover, the study conducted by Wali and Grindrod (2016) shows that health literacy plays a significant role in treatment progress. It was reported that patients with low health literacy are 10 to 18 times less likely to adhere or correctly identify their medication than those with adequate health literacy skills. Some patients have difficulties in understanding health information, forget to take medications, want more instructions and information on side effects, have a poor understanding of medication information and how to make suitable health decisions; in these cases, tailored medication counselling is required to meet their basic needs (Ngoh 2009). In some disease conditions, more than 40% of patients sustain significant risks by misunderstanding, forgetting or ignoring healthcare advice (Andrew Martin et al. 2016).

2.2 Existing mHealth Work to Improve MA

Studies on mobile phone technology interventions to improve MA categorised the interventions into three main categories: *voice calls*, *mobile phone text messaging* and *mobile phone apps*. As per the systematic review by Anglada-Martinez et al. (2015), most studies demonstrated improved clinical outcomes. Moreover, in the integrative review conducted by Park et al., 22 out of 28 studies validated the effectiveness of mobile technology in improving clinical outcomes due to improved MA (Park et al. 2016).

2.2.1 Voice Call Interventions to Improve MA

In a review study of Griffiths et al. (2017), patients received telephone calls after the first, second and fourth week of the intervention. Voice calls are used in many MA interventional research to follow-up and collect feedback during or after the study ends according to the systematic review conducted by Rootes-Murday et al. (2017). However, it was difficult to conclude that it is the best solution over a short period. Additionally, voice calls are less feasible compared with text messaging and mobile apps.

2.2.2 Text Message Interventions to Improve MA

In a study conducted by Dekoekkoek et al. (2015), 9 out of 13 studies showed adherence rates improved by 15% to 18% when using text messages to promote MA. Text messages that were standardised, tailored, one- or two-way and timed either daily, weekly or monthly according to the medication regimen showed improvement in MA. The authors set guidelines for the future development of text messages and recommended translating evidence into practice through implementation.

Kannisto KA et al. explored patients' feedback on receiving SMS reminders on antipsychotic medication for 12 months. The participants filled a survey which was designed using existing literature on service experience and technology acceptance model. Their study concluded the use of simple existing technology such as mobile phones and SMS was endorsed by the participants (Kannisto et al. 2014). In the paper, *Mobile Phone Interventions for the Secondary Prevention of Cardiovascular Disease*, conducted by Park et al. (2016), the majority of the studies had a 79% effectiveness in improved outcomes with the use of text messaging and mobile app reminders. However, the reasons for 21% failure were not justified or reported. In a three-month study of asthma treatment, the patients were randomised to receive or not receive a daily SMS reminder. The study concluded that the mean adherence rate increased from 77.9% to 81.5% for the ones who received SMS reminders. However, they did not mention any reason for the 18.5% who showed no improvement, and it is unclear if they were not adherent, or they did adhere to the medication, but their health did not improve, or they did not receive the SMS (Strandbygaard et al. 2010). This leads us to highlight the importance of smartphone apps that evolve much faster than other techniques, and, because apps can be validated and updated over a specific period, more features can be added to the initial version.

2.2.3 Mobile App Interventions to Improve MA

Currently, there are approximately 2.53 billion smartphone users worldwide, including healthcare providers, consumers and patients who can potentially use healthcare apps (Statista 2018). Kennely et al. (2016) argue that mobile health technology could save the healthcare system approximately 290 billion US dollars in medication management costs. However, the vast increase in the number of mHealth apps worries healthcare providers, due to risks which may be a violation of users' online privacy, or offer dubious medical information and advice (Aitkin et al. 2017). Several studies have presented the beneficial effects of mobile apps in terms of patient compliance and quality of life in various disease situations (Hamine et al. 2015). Few studies looked at smartphone apps, such as MedLink, which examined the feasibility and acceptance but not the effectiveness of the app, MA detected was 82%. Participants showed a significant decrease in depressive symptoms on health questionnaire and the Quick Inventory of Depressive Symptomatology and their challenge was further evaluation of MedLink through a randomised controlled trial to evaluate the efficacy of the improvement of processes of care, symptoms of depression and patient adherence (Rootes-Murday et al. 2017).

Moreover, the study "Don't Forget Your Pill!" (Stawarz et al. 2014) aimed to report the findings of a functionality review of 229 medication reminder apps, highlighted the gap between the theory and practice. It also demonstrated how apps could be implemented to move from passive alerts to a smarter memory and routine assistant. They concluded that regardless of the type, functionality or complexity of the app, the snooze option is rarely available. Moreover, taking medication is a routine task, and the functions that explicitly support routine-based reminders are not available. Their challenge was that the functionality of existing apps' lack of support for personalised daily routines, to add notifications, and to allow post-completion checks. Despite the vast positive results on mobile app interventions'

contribution to solving the MA dilemma, gaps remain in understanding how these solutions may fail when applied in a clinical setting.

3 METHODOLOGY

We used online and face-to-face semi-structured interviews with healthcare professionals and health technology designers. The purpose was to gain a deeper understanding of their perceptions towards MA and the approaches they might have used in the past. The interviews were audio-recorded. All recordings transcribed and deconstructed for analysis. In this study, we used semi-structured questions to allow the participants to approach the subject from their experience, as listed below:

- How can you describe MA?
- What do you think about the way MA is promoted today?
- Have you been involved in any MA initiatives?
- What do you think about technology-assisted MA?
- What benefits could we achieve by introducing solutions for MA?
- What challenges do we anticipate?
- What implementation implications do you envisage?
- Would we require wider support to make similar solutions successful?

We used purposeful sampling to select participants (Martin 1996). The participants were selected through LinkedIn based on the following criteria; work in New Zealand and has the role of a Healthcare Professional or Technology Designer, or Pharmacist or Nurse or a researcher in the field of health informatics. In the recruitment process, experience and workplace were considered. The participants at the time of the study were working in Hospitals, Pharmacists, GP Clinics, Tech industry and Universities in New Zealand researching in Health IT domain. Recruitment and data collection continued until when it became clear that there was no new information provided or repetition of information from several participants, which means the saturation of data has been reached for this topic. Particular attention was paid to the data contradicting with theoretical relationships, to avoid the research bias from the literature review.

The Grounded Theory (GT) to analyse the data is utilised. GT is a qualitative methodology; defined as 'the discovery of theory from data', which is systematically obtained and analysed (Urquhart 2013). GT can utilise in-depth interviews as one of its data collection methods. GT has both the process of category identification and integration (as a method) and its product (as theory). GT as a method provides us with guidelines on how to make links between categories and how to establish relationships between them (Strauss and Corbin 1998). Hence, it provides an explanatory framework to gain a deeper understanding of the phenomenon of the study. GT as a theory is the end-product of this process. Coding is an essential step in GT, Strauss states, "The excellence of the research rests in large part on the excellence of the coding" (Strauss and Corbin 1998). Grounded theory method implies data coding, "a bottom-up technique in relation to the data, and begins at the word or sentence level" (Claser and Strauss 1967).

4 FINDINGS AND DISCUSSION

Twenty-three experts from a multidisciplinary background team (from the healthcare sector (17), health technology design (4) industry and health informatics researcher (1)) participated in this study. The area of expertise of the participants can be expected to have a different perception of MA and the approach of technology-assisted MA.

Several initial codes were identified for each interview question during the analysis phase. As more codes emerged, the data were clustered into focused codes, which led to more generalised categories. With theory building in mind, the categories were organised as themes. From the main themes, the theoretical relationships were mapped out. Attention was paid to the data contradicting with theoretical relationships, to avoid research bias from the literature review.

For the sake of simplicity, we have presented the summary of the quantified codes and categories as shown in Table 1. These categories are Patient Characteristics, Collaboration between the health team, placing the patient at the centre of the health circle, Medication Impact effectiveness and side effect, and the Technology Acceptance.

Categories /Themes	Patient Characteristics	Collaboration	Medication Impact	Use of Technology
Focused Codes (Number of occurrences)	Patient education (24) Patients attitude (13) Adoption (4) Affordability (8) Patients demographics (16)	Involvement (18) Data collection (48) Data sharing (22)	Medication literacy (71) Medication effect (31) Patient experience (21)	Accessibility (51) Simplicity of use (36) Time constraint (146)
Total	65	88	123	233

Table 1. Quantified categories and focused code

This research focused on the relationship between the themes as a process that eventually affects patients' health outcome positively. No single model fitted our study plan. Therefore, a conceptual model was developed, integrating the themes from the preliminary data with the existing MA models (Sirur et al. 2009; Timmerman et al. 2017), as shown in Figure 1.

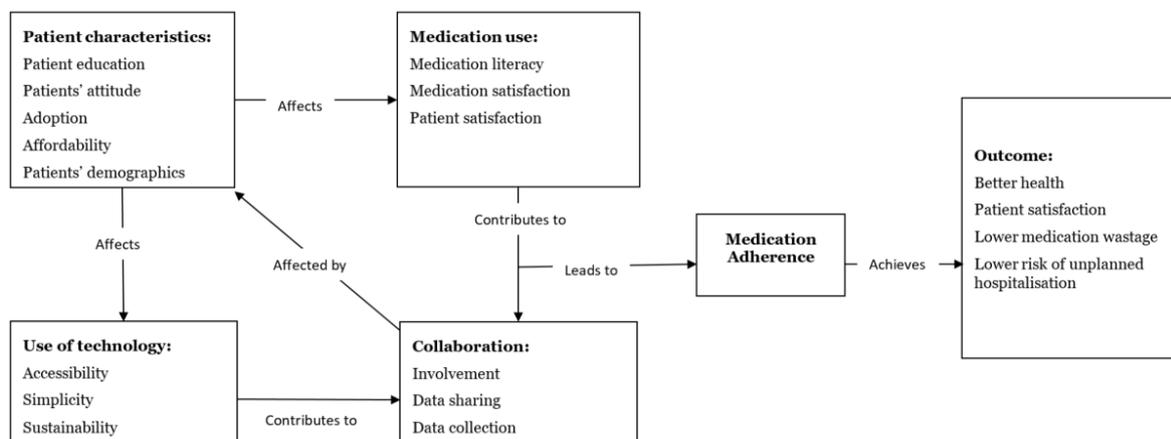


Figure 1: Medication adherence conceptual model

We have presented the findings in this section along with the discussion according to the themes laid out by the research question. The five themes were described and supported with illustrative quotations of the interview extracts as direct quotes from the transcribed interviews.

4.1 Patient Characteristics

The first theme is the patient characteristics which is related directly to the patient or within his ability, and it involves patient education, patient attitude, adoption, affordability and patients' demographics in terms of age and ethnicity only. Studies proved significant disparities in the intensity of adherence to medication between women and men and their likelihood of receiving guideline-based therapy for using their medication (Manteuffel et al. 2014). However, unexpectedly the gender factor is unstated in the interviews by any of the participants. Moreover, the healthcare consultants regarded involving the ability of the patient, which can be the physical ability or the mental ability to comply with medication is extremely important and contributes to MA. Therefore, if technology will allow continuous monitoring or feedback, they can achieve better health outcomes, better patient experience, a better quality of life and minimising side effects.

Examples of the interview extracts are provided in order to characterise the nature of the data used in this study.

- "I define adherence as more of an understanding of why they have to take their medication regularly."
- "once they are educated and they know the importance of it they will continue to take it."
- "A lot of patients are defiant and don't want to admit that they have a problem."
- "the only challenge would be to educate patient first."

- “some people might be on an anti-depressant and they want to take a herbal remedy and they shouldn’t really. Adherence is a holistic thing, it’s not just about when you take your medicine, it is about understanding. So I think if there’s a feature on there, which will give you some more information about what you can take, is this safe to take? Because a lot of people now they buy things online, a lot of people don’t actually come into the pharmacy, they’ll buy natural supplements on-line. “
- “understand how to adapt medications to their own circumstances”

4.2 Collaboration

This category represents what is related to involving patients, health team and family members and carers in the healthcare circle considering the patient at the centre of the circle with the privilege of empowerment to take charge of his treatment. Health data sharing as a centralised database to eliminate errors of multiple data sources. And data collection where the patient can feed some information back to specific members of the health circle to support him during the MA plan and process. A related study found that patient-driven healthcare can be characterized as having an increased level of information flow, customization, collaboration and responsibility-taking, as well as predictive and preventive facets (Swan 2009). Examples of the interview extracts are provided in order to characterise the nature of the data used in this study:

- “I think the first thing is a better communication”
- “Know the time of meds missed and solve that particular time frame”
- “help us understand and detect patterns of how the patients are taking their medication”
- “Patients don’t remember which medication they are taking when they are admitted to hospital”
- “first any tool has to have a pharmacist involvement and first of all find out why, and what their beliefs are. Then, put the right tool in place.”
- “I definitely think clinicians should be involved, they just need to know if something is wrong will make a note in the system... it’s all about avoiding re-hospitalisation.

4.3 Medication Impact

This category represents what is related to medication impact or medication use: medication literacy, medication effect and patient experience with medication. According to Health Consultants, the medication regimen is complex, and advanced interventions are needed to support patients with their medication. However, they were certain that results depend on lifestyle when it comes to young people, as the age factor contributes heavily to adherence.

Examples of the interview extracts are provided in order to characterise the nature of the data used in this study.

- “where people with mental health clients, medication adherence, or medication compliance is seen as a requirement rather than part of their health plan.”
- “There’s probably not as much focus on specifically around taking them the right way or at the right time.”
- “it’s about reducing the number of meds... That’s called medicine therapy assessment.”
- “it’s still not going to work on the person that doesn’t want to take their medicine for a certain reason.”

Adherence is challenging, especially with medications that have substantial side effects and potentially used by very young or elderly populations. According to the GPs hospitals, readmissions relates directly or indirectly to MA.

4.4 Use of Technology

This category covers the patients and healthcare team use of technology, which represents what is related to accessibility in terms of being able to access it easily by all the circle members and compatible with the available systems used, also by reaching the right people who want to be part of the process. Also, there is simplicity, so the technology needs to be simple to use, acceptable by the end-user. Then, there is the time constraint which is part of any software development process or any new project and the treatment time, which also affects the results of the technology use or the treatment outcome.

Examples of the interview extracts are provided to characterise the nature of the data used in this study.

- “People who have problems remembering their medication, they use an intervention to texting and phone calls to remind them about their medication.”
- “it’s about reducing the number of meds... That’s called medicine therapy assessment”
- “The most beneficial thing about introducing this is to give an idea of the patient’s actual medication taking history.”
- “I would say that the app itself serves as a measure of motivation and encouragement, so personally I would say they’d be two different approaches, though the idea that the app is one strategy and then family and friends is another one.”
- “Nowadays everyone is using phones and even in the elderly population are but it’s a matter of them being able to access it... so if it’s very complex it might not be worthwhile and it might not actually do anything.”
- “The pharmacy, you sign up, and they can all see if the patient has been double dipping in other pharmacies “

Therefore, they considered merging technology and healthcare is the solution that can help the population, and it needs to be implemented within the health system to improve the process and lower cost.

Having a technology-driven solution will be valuable to the healthcare organisation, to the patient, to the caregivers, family and community. A simple app that does the medication reminding might work, or SMS messages might also be good because they do not need to be downloaded. But with the app, it will include more functionality like acknowledgement and history of taking medication. However, it has to be simple to use and continuously improved to have a nice-looking interface that people will accept avoiding a strong clinical background in terms of health research.

5 CONCLUSION AND FUTURE WORK

In this paper, we developed a conceptual model based on healthcare professionals’ and health technology designers’ insights into poor MA and a method for improving MA by using mHealth. The 23 participants interviewed in this study were concerned about poor MA, which, according to them, prevents patients from fully benefiting from their prescribed medications.

The healthcare professionals expressed concerns about the consequences of not taking medication as prescribed and the resulting risk of failing to achieve the expected improvements in health outcomes within a specific period. The pharmacists stressed on having patients fill in prescriptions on time and prevent wastage of medication through medication literacy. The technology designers and researchers were interested in utilising technology to solve some of the problems related to time constraints, human errors, and accessibility.

The interviewees suggested many ideas to mitigate the problems caused by a lack of MA. A few key insights include the patients’ ability to engage in their courses of treatment, collaboration among members of healthcare teams, placement of patients at the centre of the healthcare circle, explanation of the potential effectiveness and side effects of prescribed medications, and acceptance and simplicity of technology usage.

The strength of this study was our comprehensive sampling of the participants, who included healthcare professionals in direct contact with patients and health technology designers experienced in developing technological tools for patients. The interviews were analysed to define the underlying themes and subthemes. Moreover, we continued participant recruitment until the data were saturated. These findings will contribute to improving our understanding of the complexity of MA. The limitation of this study is the lack of patients’ insights on dealing with adherence issues. In the future, MA can be investigated from the perspective of patients. Moreover, mHealth can be developed to address concerns pertaining to MA through improved and secure communication between patients and healthcare teams.

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