Gamified Medication Adherence Applications for Chronic Health Conditions: Scoping Review

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Abstract. This scoping review aims to identify the gamification mechanics used in designing gamified mobile health applications to support medication adherence behaviour among people living with chronic conditions. The process of Arksey and O'Malley's framework was used in conducting this scoping review. Five databases were searched for eligible studies, including PubMed, Scopus, Science Direct, Web of Science, and ACM. Data charting characteristics included author, year, country, chronic health condition, application name, research method, data collection instruments, health behaviour change models, gamification elements and mobile health features. Seven studies were examined in this review. In addition to gamification mechanics, health behaviour change and motivation theories were used to design the interventions for chronic disease patients. Interventions reported positive impacts on medication adherence rates, mobile app usage, and patient motivation. All included studies used progression, goal setting, feedback and rewards mechanics incorporated with medication adherence features. Seven gamification mechanics were identified that could be used for medication adherence and health education. This review's findings suggest that medication adherence applications using gamification elements improve adherence levels for different chronic health conditions.

Keywords: Gamification · Mobile Health Applications · Medication Adherence · Scoping Review

1 Introduction

Chronic disease patients need to modify unhealthy behaviours and adopt healthy habits to help manage their disease and improve their quality of life [1]. Medication non-adherence is a common challenge among people living with chronic diseases and can negatively impact the treatment's effectiveness and patients' health outcomes if not managed effectively. Patient education and engagement are critical in supporting medication adherence behaviour. Patients must understand the importance of treatment and how their medications will help control chronic conditions. This can be supported by providing chronic disease patients with novel technologies designed to empower patients to support medication adherence behaviour [2, 3].

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J. Ham et al. (Eds.): PERSUASIVE 2023, LNCS 13832, pp. 307–321, 2023.
https://doi.org/10.1007/978-3-031-30933-5_20

Mobile health applications (m-health apps) have been successfully used to improve medication adherence and enhance the accessibility of healthcare services leading to optimal health outcomes [4–6]. The applicability of the persuasive systems design features in medication management applications has been studied in [7] and identified that reminders, tailoring and monitoring features had been the most cited features. In addition to these features, gamification design is used in medication adherence applications to motivate users and support health behaviour change [8]. The persuasive architecture of gamification in health applications depends on the game elements that make the process more engaging and enjoyable [9]. Game elements are activities, behaviours, and mechanisms designers incorporate into a specific context to create a gameful experience [10–12]. Using game design elements positively impacts individual adherence across different fields [13]. In addition, it improved the persuasiveness of m-health apps in various health disciplines and enhanced the user's competence in managing chronic health conditions [8, 9, 11, 14]. Cugelman [9] found seven gamification elements linked to proven health behaviour change techniques used to design gamified health systems, including goal setting, challenges, feedback, rewards, progression, social interaction, and fun. De Croon et al. [13] identify points, feedback, leader boards and social interaction as the most frequently used game elements for adherence across multidisciplinary applications.

Ahmed et al. [8] conducted an app review and found that only 1% of medication apps in Apple and Google stores have used gamification design; there is a need to investigate medication apps designed for specific diseases (e.g., chronic illnesses). The gamified medication adherence application design that positively impacts chronic disease patients needs to explore game elements and mobile app features and how they can support patient adherence [15, 16]. Different studies suggest gamification design frameworks for m-health applications targeting chronic health conditions; however, they do not focus on how the gamified apps can improve patients' adherence [17, 18]. Therefore, there is a need to explore how gamification elements are designed for medication adherence to support chronic disease patients. This review aims to identify the game elements and mobile health features used in designing gamified medication adherence applications for different chronic health conditions. The seven game-design elements proposed by Cugelman [9] are used in this review to extract the game-design elements and how these elements were incorporated with medication adherence features.

2 Methodology

2.1 Study Design

This scoping review aimed to identify the main concepts and knowledge gaps in using gamification design in medication adherence mobile applications. The scoping review can provide a researcher with an overview of how previous studies have designed and evaluated gamified apps for chronic health conditions in the context of medication adherence support. The research team followed the five steps to conduct scoping review described by Arksey and O'Malley [19], which include: finding the research question;

identifying relevant evidence; selecting relevant studies; extracting the data; and collating, summarising, and reporting the findings. The preferred reporting items for systematic reviews and meta-analysis (PRISMA) extension for scoping review were followed in reporting the results [20]. The study focused on identifying game elements and mobile health features used to design gamified medication adherence applications for people with chronic diseases. Hence, the research question was: *What are game elements used in designing medication adherence applications to support chronic health conditions?*

2.2 Identifying Relevant Studies

The team designed the search strategy to be comprehensive and include studies relevant to gamification design in medication adherence apps for chronic health conditions. Five databases, including PubMed, Scopus, Science Direct, Web of Science, and ACM, were searched to identify eligible studies. The search included studies published in English between 1 January 2010 and 15 August 2021, as gamified e-health applications began in 2010 [11]. The keywords used during the searches were: ("Gamification" OR Gamiful OR Gamifi* OR "Gamified" OR "Playful" OR "Game design" OR "Gameful") AND ("mobile health" OR "eHealth" OR "digital health" OR "smartphone" OR "mobile app" OR "mobile applications" OR "mHealth" OR "smartphones") AND ("Medication adherence" OR "Medication compliance" OR "Pharmacological adherence" OR "Adherence" OR medications).

2.3 Inclusion and Exclusion Criteria

A Population, Concept, and Context (PCC) [21] framework was used to determine the selection criteria. **Population:**: individuals with chronic health conditions. **Concept**: all gamified applications are designed to enhance medication adherence behaviour. **Context**: m-health apps. Any study that met the following criteria was included: (i) Design and development of gamified medication adherence applications for chronic health conditions, (ii) Evaluation of gamified medication adherence applications for chronic health conditions. Exclusion criteria included: (i) Reviews, study protocols, opinion papers, books, and reports, (ii) Studies related to video games, exergames, and gamification in other fields, (iii) Studies not for chronic health conditions or did not use m-health applications and (iv) Studies that were not in English.

2.4 Charting the Data and Analysis

After removing the duplicate articles, two reviewers (Author 1 and Author 3) independently screened the titles and abstracts of the articles, and if there is any disagreement will be discussed with the third reviewer (Author 2) to reach a consensus. All reviewers come from academic backgrounds and are familiar with persuasive technology design in m-health applications. The characteristics of included studies were extracted, and each study was categorised based on author, year, country, health condition, research method, data source (e.g., survey, interview, etc.), participants' information, game elements and mobile health features (see Table A1 in the appendix). The reviewers summarised and synthesised the available data. The game design elements and m-health features were mapped to understand how m-health features were gamified to support patient adherence.

3 Results

3.1 Selection of Included Studies

The results of the search in the selected databases were imported into Endnote. Initially, 1072 articles were retrieved from the database searches. In total, 658 papers remained after removing duplicates and filtering articles based on eligibility criteria. After screening titles and abstracts, 581 articles were excluded that did not meet the criteria, and 77 articles were selected for full-text assessment. Finally, nine (9) studies met the study criteria and were selected for analysis (see Fig. 1).

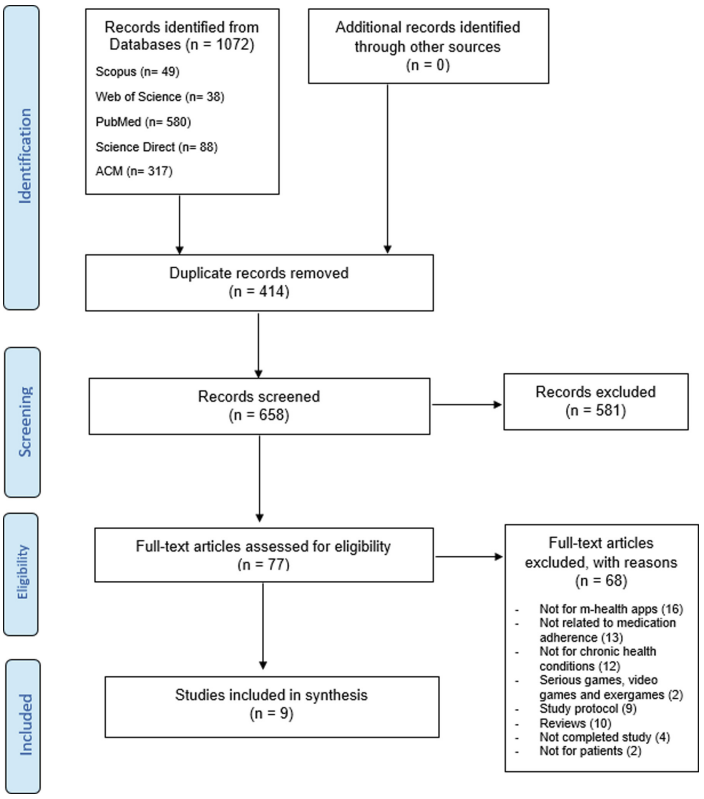

Fig. 1. PRISMA flow diagram

3.2 Study Characteristics

Table 1 presents information about the characteristics of the included studies, which investigated gamified medication adherence applications in Human Immunodeficiency Virus (HIV), asthma, diabetes, gastrointestinal diseases (GI), and one application for multi-morbid chronic health conditions [22–30]. Most of the studies were conducted in

the United States of America (USA) [22–24, 27, 29] and other studies from different countries, including Portugal [28], Austria [30], Australia [26], and Canada [25]. Five studies adopted a mixed methods research approach to design and develop gamified medication adherence applications, and one study used qualitative data to build the gamified medication adherence app [22–25, 28, 29]. Three studies evaluated the effectiveness of gamified medication adherence solutions to assess the effect of using gamified medication adherence applications on clinical outcomes and medication adherence rates. The evaluation duration was one to six months with the quantitative research studies [26, 27, 30].

Table 1. Studies characteristics.

App name	Year	Condition	Theory	Method	Instrument	Participants age
Epic Allies [24]	2016	HIV	IMB	Mixed method	Focus groups, surveys	20–28
AllyQuest [23]	2018	HIV	SCT; FBM	Mixed method	Focus groups, Surveys, Interviews, Usage data	16–24
InspirerMundi [28]	2021	Asthma	FBM	Mixed method	Interviews, observational study, Surveys	17–40
AsthmaHero [22]	2016	Asthma	FBM	Mixed method	Focus group, Usage data, and Surveys	11–19
MySugr [30]	2019	Diabetes	N/A	Quantitative	Usage data and Surveys	N/A
MedVenture [29]	2021	GI	SDT	Qualitative	--	12–18
Bant [25]	2012	Diabetes	N/A	Mixed method	Surveys and Usage data	12–16
DiaSocial [27]	2018	Diabetes	Regulatory mode theory	Quantitative	Surveys, Usage data and Clinical out-comes	Average: 67
Perx Health [26]	2020	chronic diseases	SDT	Quantitative	Usage data	Average: 43–45

Six studies discussed the design and development of gamified medication adherence applications. Health behaviour change theories guide the design process of gamified medication adherence support applications. Then the design team employed prototyping with users involved in the app assessment [22–25, 29, 31]. Other studies started by

applying users from the beginning to specify the requirements, and the outcomes of the user research were used in building the app prototypes, and then the app was evaluated by users [25, 29, 31]. User involvement and iterative design were necessary to create the best-gamified medication adherence application that was useful, engaging, and satisfied users' needs [23, 24, 28, 29]. Four studies involved healthcare professionals in the development process to ensure the application's trustworthiness [24, 25, 29, 31]. The Epic Allies application used The Information-Motivation-Behaviour model (IMB), and the AllyQuest app employed two theories, including the Social Cognitive Theory (SCT) and Fogg Behaviour Model (FBM) for persuasive technology and narrative communication theory [23, 24]. The FBM is the most health behaviour change model employed, which aims to improve skills and motivations and provide triggers that could drive positive health behaviour change [22, 23, 28]. MedVenture employed Self-Determination Theory (SDT) to design the gamified medication adherence application that could satisfy the three psychological needs: autonomy, competence and relatedness [29]. The regulatory mode theory was used to evaluate gamified applications and explore the different personality types of diabetic patients who used DiaSocial to improve adherence behaviours and health outcomes [27]. The evaluation studies assessed the apps using experiments, feasibility, acceptability, and usability evaluations; it was observed that studies began the app evaluation with a small number of participants before evaluating the efficacy of the intervention with a large number of patients [22–25, 28].

3.3 Gamification Elements and Mobile Health Features

All identified studies used the medication adherence features of reminders and medication trackers for doses to support chronic disease patients and empower self-care (see Table 2). The use of reminders could prevent unintentional nonadherence behaviour. Still, some younger chronic disease patients considered unnecessary reminders disturbing and could demotivate them from continuing to use the application [22, 24]. Health educational features are incorporated with game elements to support health behaviour change and enhance patient knowledge and skills [23, 24, 26, 30]. Gamified medication adherence apps were connected with medical devices to simplify self-monitoring activities, especially for diabetes and asthma patients [22, 25, 26, 32].

Table 2. Mobile health features

Category	Features	References
Medication management	Medication schedules	[26, 28–30]
	Medication image	[26, 28]
	Medication history/ trackers	[22–30]
	Reminders	[22–30]
	Refill alerts	[23]

(*continued*)

Table 2. (*continued*)

Category	Features	References
	Drug-to-drug interaction	[23]
	Tailored adherence strategies	[23, 28, 29]
Self-monitoring	Track symptoms	[22–30]
	Food intake	[30]
	Physical activity	[30]
	Visualize health measurements	[23–30]
	Health assessment tools	[28]
Health education	Informational modules	[23, 24, 26, 30]
Social support	Medical social network	[25, 27, 29]
	Peer support	[23, 28, 29]
	Share information	[22, 28–30, 32]
	Communicate with health professionals	[27, 28, 30]
General	Connected with other devices	[22, 25, 26, 32]
	Multiple languages	[27, 28, 30]
	App tutorial	[24]

In medication adherence applications, gamification elements were employed to support health behaviour change and patient motivation and improve user engagement. It was noted that medication adherence features were gamified by setting goals related to medication management, health monitoring or health education. Based on the user progression, the apps provide the user with feedback and rewards for successful behaviour. Our results demonstrated that most studies use the following combination of elements: progression, rewards, feedback, and goal setting (Table 3). The selected studies used several mobile health features that focus on different dimensions, including medication management, health monitoring, health education, connectivity and other general features. Table 4 shows the seven gamification elements and how they were combined with each medication adherence feature.

Progression. Gamified medication adherence apps provide users with a profile that represents the user identity and shows their progression towards health goals. Different methods were used to record and track the user progression, including: points, progress bars, level-ups and leaderboards [26, 28, 31]. Avatars were used to show user identity within the app, and personalised avatars were preferred by chronic disease patients [22–24]. Chronic disease patients preferred visualisation and quantification features to measure and show their adherence over time [22]. Users could earn points when they learn new facts about the disease or medication use [26]. Diabetic patients earned points for performing blood glucose tests three times or more per day and were allowed to level up when they achieved a certain number of points [25]. Moreover, they can learn from

Table 3. Gamification elements

Application name	Progression	Feedback	Rewards	Goal setting	Challenges	Social interaction	Fun
Epic Allies [24]	X	X	X	X	X	X	X
AsthmaHero [22]	X	X	X	X			X
AllyQuest [23]	X	X	X	X	X	X	X
Perx Health [26]	X	X	X	X	X	X	X
MySugr [30]	X	X	X	X	X		X
Bant [25]	X	X	X	X		X	
DiaSocial [27]	X	X	X	X	X	X	
InspirerMundi [28]	X	X	X	X	X	X	X
MedVenture [29]	X	X			X	X	X

their previous experiences through the historical adherence data and glucose levels on each occasion, which could support the patient's decisions [30].

Feedback. Personalised feedback based on regular health assessments could support health behaviour change and make the application activities more relevant [23, 24]. Providing users with positive feedback about their success in health monitoring activities improved adherence self-efficacy, the user engagement and helped users identify their adherence difficulties [24, 32]. The MySugr app was designed to be visually attractive and offer positive feedback based on successful behaviour [30]. The MySugr app enabled users to share data with their physicians and communicate with qualified healthcare providers for assistance when needed [32]. Asthma patients preferred the application messages to be personalised and to consider the patient's lifestyle [22].

Goal Setting. Daily goals enabled users to engage with the application and adhere to their medication requirements [28, 30]. System designers provided users with various goals to improve medication adherence, self-care, social interaction and health education [22–28, 30]. The Allyquest app enables HIV patients to learn and develop new skills related to routine self-management activities to improve their competence in managing and adhering to medications [23]. In gamified medication adherence applications, goals should be manageable and challenging, motivating users to increase their medication adherence levels [26]. Gamified apps enable users to connect with mobile health sensors or other devices to simplify the data entry for health goal monitoring [22, 25, 26, 28, 30].

Rewards. Different gamified medication adherence applications incentivise users to encourage the use and enhance medication adherence behaviour [22–26, 28]. Users were provided with daily routine tasks related to medication management and users were rewarded when they completed these tasks [26]. Asthma patients were rewarded with points when they performed different tasks such as: adding new medicines, updating the medication schedule, learning about the disease or the medication use, completing the health assessment questions and notifying other users to take their medication [28]. Rewards in the Bant app were associated with increasing self-monitoring activities for diabetes patients, which could elicit healthy behaviour change [25]. Badges were used as an internal reward for completing goals or encouraging other users to improve adherence behaviour [28]. Lottery-based rewards were used to improve medication adherence behaviour by providing users with non-predictable rewards for taking medications on time [26].

Challenges. Provide users with challenges related to self-management, physical activity, nutrition, and maintaining the app's use. Some apps challenged users to perform daily health measurements, and users will be rewarded for completing the task. Users were also rewarded for maintaining their blood glucose levels in the normal range over certain days [30]. Users could cooperate with other users to complete difficult challenges within the app games [24].

Social Interaction. HIV patients considered social support components vital as they were motivated to adhere to medications and accept HIV care. This could be because the patients felt less lonely knowing that other patients took the same medication(s) [23, 24]. Social support could positively impact patient motivation to adhere to prescribed medications [24]. Users could share their achievements via social media networks and share the medication schedule with friends, family or other app community members to support medication adherence [28].

Fun. Mini-games were incorporated with gamified applications as an easy, fun way to encourage users to complete tasks and improve the user experience [24, 28, 29, 31]. Mini-games for health education use narratives and challenges to engage users with the game story and assess the user's knowledge with simple questions. [28, 31]. Virtual characters were employed in the gamified apps to give users a tour and introduce the app features and storyline, which could help them learn more about the app use [24, 28]. Role modelling was used with storytelling to elicit health behaviour change [23].

3.4 Gamified Medication Adherence Applications Outcome

Most studies reported positive outcomes in different aspects, such as high user satisfaction, increased medication adherence rates, increased patient motivation and the use of m-health apps.

Medication Adherence Rates. Three studies found that gamified apps improved adherence rates. Perx Health app showed a high adherence rate for different chronic disease patients, averaging over 85% across the study period. According to the study, adherence

Table 4. Game elements and medication adherence features

Features	Progression	Challenges	Rewards	Feedback	Goal setting	Social interaction	Fun
Medication management	X		X	X	X	X	
Self-monitoring	X		X	X	X		
Health education	X	X	X	X	X	X	X
Social support	X	X	X	X		X	X
General	X				X		X

rates remained optimal over time, but a slight decline was not statistically significant [26]. For asthma patients, the adherence level for inhalers was 75%, whereas, for other medications, it was 82% [28]. Users who collected a large number of points within the gamified application showed better health outcomes [27].

The Use of m-health Apps. The frequency of health data measurements in the Bant app for diabetes patients increased by 50%, and users were interested in continuing to use the app [25]. AllyQuest App found that the high use of the application positively affects self-management outcomes, patient knowledge and ability to manage medications [23].

The User Experience. Reminders, points, adherence graphs, and rewards in asthma management applications improved the experience of medication taking and disease management [22, 28]. Some gameful m-health apps offer chronic disease patients with virtual coaching features. This feature helps users to learn more about the condition and make informed health decisions that could improve patient empowerment and healthcare quality and reduce healthcare costs [32].

User Satisfaction. The use of the MySugr App positively impacted user satisfaction and ability to control their blood glucose. It was noticed that the app affected the group of patients with less glucose control [30]. User satisfaction was high for diabetic patients in the Bant application, and users were interested in continuing to use the application [25]. Gamified medication adherence applications supported intrinsic and extrinsic motivation by reminding the users to complete self-management or monitoring tasks and rewarding them based on their adherence behaviour [25, 26, 32]. Using rewards and praise immediately following medication intake could motivate users to maintain optimal adherence and continue taking the medications as prescribed [26]. HIV participants were satisfied with the gamified application and interested in using the system again and recommending the application to friends if they needed it [23].

4 Discussion

The results suggested that gamification elements in m-health apps are used to reduce nonadherence rates, improve user experience and satisfaction, and motivate users to

continue using medication adherence applications. Motivation is a significant factor in supporting medication adherence behaviour, and m-health apps could support user motivation through gamification elements that have a positive effect and meet user needs [33, 34].

4.1 Main Findings

The findings of this paper showed that most studies employed the combination of progression, feedback, goal setting and rewards to motivate and engage users with gamified applications and improve adherence levels. Gamification elements could support intentional nonadherence (especially feedback and progression), whereas mobile health features can help users with unintentional non-adherence. Gamified apps that provide relevant health information and enable users to set health goals have improved patients' capability and competence in managing medications [13, 39]. Health education features with gamification elements should motivate users to learn about safe medication use and access credible content that shows the importance of a healthy lifestyle and medication adherence in disease management. This could help patients to realise the importance of adherence and improve their competency in medication management. The features of medication management and health education combined with health behaviour change techniques reduced nonadherence behaviour for individuals with chronic health conditions [26]. The app content needs to be educational, cover all medication management tasks, and be enjoyable to engage the users by showing their progression in learning, challenging them to learn or adopt new healthy habits related to medication management and a healthy lifestyle. Gamification elements should be tied to informative content and the persuasion context of the system [11, 14]. Reward the users with different rewards when they complete health education tasks. Empower users to learn from others by interacting with other users that have a similar condition or treatment plan. As presented in the MySugr app, chronic disease patients should have easy access to health coaches who can provide users with the information and training required in treatment management. These efforts could decrease intentional nonadherence and ensure that patients are aware of the risks associated with nonadherence behaviour. Self-monitoring features can be gamified by providing users with goals that are designed to improve medication adherence and health behaviour changes. Users should feel a sense of progression and receive feedback that encourages users to continue performing healthy behaviours. Personalisation, visualisation and quantification are critical features in gamified applications that make the use of applications more useful and relevant. Personalised features are significant and should be considered to meet the needs of different users [35]. This review showed that most development studies are guided by health behaviour change models to design gamified medication adherence apps. The Fogg Behaviour Model (FBM) of persuasive technology was used in designing gamified applications and supporting medication adherence for different chronic health conditions, such as asthma and HIV apps [22, 23, 28]. Persuasive design in gamified medication adherence apps aims to simplify the medication management process and provide chronic disease people with a sense of belonging. Moreover, offer prompts to promote health behaviour change and habit formation, praises user progression, and rewards successful behaviours.

4.2 Design Recommendations

The gamification design process should focus on the context of use and involve interdisciplinary stakeholders to improve motivation and persuasion [14, 36]. User-centred game design can support intrinsic motivation and create a sustainable engagement by satisfying user needs [11, 26]. Most studies have involved young patients in the development studies, while older patients were only involved in the evaluation studies. Gamification elements are not one size fits all; as a result, the designer should consider the different personalities of users and understand their preferences to select appropriate elements that motivate users to adhere to the treatment [27, 30]. Most gamified medication adherence applications were designed in developed countries, which is consistent with previous studies in gamified e-health literature [11]. Future gamified medication adherence support applications should provide users with more goals, challenges and levels to support health behaviour change [27]. Challenges in gamified medication adherence apps help users to collaborate with others to achieve their health goals, whereas in gamified physical activity help users to compete with each other. Not all game elements that are used in other gamified health apps can be used in apps that designed to support medication adherence. Different chronic health conditions can be investigated to make using m-health apps for medication-taking enjoyable and rewarding.

4.3 Limitations

The scope of this study is limited to studies published in academic journals, and grey literature is not included in this review. Gamification elements and mobile health features are extracted from the identified manuscripts rather than the actual app. Not all identified studies provide detailed information about the development process and only mention the used game elements and how they were evaluated.

5 Conclusion

Medication management is an ongoing process for chronic disease patients, and gamification design makes the process enjoyable, rewarding, and a source of motivation and knowledge. Gamification elements incorporated with medication management, health education, and self-monitoring could support medication adherence behaviour for different chronic health conditions. Users should have the choice and feel a sense of progression in their health goals and obtain instantaneous and personalised feedback during the application use. Health behaviour change models help gamification designers to focus on supporting the user's capability, motivation, knowledge, and socialisation. Designers should understand chronic disease patients' needs and nonadherence factors for the given disease population.

Appendix 1

(See Table 1)

Table A1. Data charting table.

	Authors	Year	Country	Health condition	Application name	Study aim	Theory	Study method	Data source	Participants age	Game elements	Category of mobile features
	Bull et al	2016	USA	HIV	Epic Allies	App development and evaluation	IMB	Mixed method	Focus groups, surveys	20-28	progression, feedback, rewards, goal setting, challenges, social interaction, fun	Medication Management, Self-Monitoring, Health Education and General Features
	Cushing et al	2016	USA	asthma	Asthma Hero	evaluation	FBM	Mixed method	Focus group, Usage data, and Surveys	11 -- 19	progression, feedback, rewards, goal setting, fun	Medication Management, Self-Monitoring, Social Support and General Features
	Schnall et al	2018	USA,	HIV	AllyQuest	App development and pilot evaluation	SCT; FBM	Mixed method	Focus groups, Surveys, Interviews, Usage data	16-24	progression, feedback, rewards, goal setting, challenges, social interaction, fun	Medication management, Self-monitoring, Health Education, Social Support
	Wiecek et al.,	2020	Australia	different chronic diseases	Perx Health	retrospective (evaluation)	SDT	Quantitative	usage data	43-45	progression, feedback, rewards, goal setting, challenges, social interaction, fun	Medication Management, Self-Monitoring, Health Education and General Features
	Fredrick Debong et al.	2019	Austria	Diabetes	MySugr	retrospective (evaluation)	N/A	Quantitative	Usage data and Surveys	N/A	progression, feedback, rewards, goal setting, challenges, fun	Medication Management, Self-Monitoring, Health Education, Social Support and General Features
	Cafazzo	2012	Canada	Diabetes	Bant	App development and evaluation	UCD	Mixed method	Surveys and Usage data	12--16	progression, feedback, rewards, goal setting, social interaction	Medication Management, Self-Monitoring, Social Support and General Features
	Michelle Dugas	2018	USA	Diabetes	DiaSocial	evaluation	Regulatory mode theory	Quantitative	Surveys, Usage data and Clinical out-comes.	65-67	progression, feedback, rewards, goal setting, challenges, social interaction	Medication Management, Self-Monitoring, Social Support and General Features
	Jácome, Almeida	2021	Portugal	asthma	InspirerMundi	evaluation	FBM	Mixed method	Interviews, observational study, Surveys	17-40	progression, feedback, rewards, goal setting, challenges, social interaction, fun	Medication Management, Self-Monitoring, Social Support and General Features
	Mehta, Moore [36]	2021	USA	Gastrointestinal disease	MedVenture	app development	SDT	Qualitative	Semi-Structured Interviews	12--18	progression, feedback, challenges, social interaction, fun	Medication Management, Self-Monitoring, Social Support

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