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REVIEW

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TEXT MESSAGES TO INFLUENCE BEHAVIOURAL CHANGES IN ETHNIC GROUPS WITH LONG-TERM CONDITIONS: A SYSTEMATIC LITERATURE REVIEW

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Key words: text messages, SMS, mHealth, long-term condition, chronic illness, self-management, positive health behaviour.

ABSTRACT

This is an international systematic review which explores the use of text messaging interventions to enhance positive behavioural changes within ethnic populations with long-term conditions (LTCs). Thirty papers were extracted from varied regions of the world after conducting a systematic search strategy using databases such as CINAHL, MEDLINE, British Nursing Index (ProQuest) and PSYCHINFO. From these papers, seven factors were found to influence adherent behaviours and the use of text messaging interventions amongst ethnic minorities: demographics- age, gender, education and literacy levels; barriers to regimen adherence; health beliefs and experiences; behavioural goals, psychological affects and outcomes; patient education and information seeking; content development of text messages. Health professionals determine the content of patient education programmes including text messaging interventions for patients living with LTCs. If core elements impeding adherence behaviours can be identified for particular individuals and patient groups at pertinent times, interventions can be targeted and may be more effective if they reflect the needs of patients. Further research is required to demonstrate, understand patient knowledge levels amongst ethnic groups and to gather their perception the content and focus of a tailored intervention.

INTRODUCTION

The use of mobile health (mHealth) is growing amongst health professionals, and the increased use of SMS shows potential for health promotion and behavioural change interventions[1]. Much of the work to explore the effectiveness of text messaging as a tool for the management of LTCs, adherence to medication regime, or improving health behaviours focuses on patients who are Caucasian and from parts of the world such as USA and Europe[2]. This suggests a gap in the literature on ethnic minority groups living with LTCs in the UK. The purpose of this literature review was twofold:

1. To identify and describe text messaging interventions that have been used in individuals within the ethnic minority population living with LTCs
2. To determine the factors and models that influence positive behaviour changes within these population groups, and examine whether such interventions were beneficial in helping them adhere to their treatment regimens and adopt healthier lifestyles.

A systematic search of current literature was conducted. The search strategy and the critical appraisal methods adopted to determine the quality and relevance of the studies retrieved are presented. Although limited papers were found on ethnic minority groups with chronic illnesses in the UK, the narrative synthesis of the findings from the retrieved papers highlights the different ways researchers have utilised text messaging interventions within ethnic populations living with LTCs across different countries[3-7].

It is important to frame a comprehensive literature review within a clearly defined objective[8]. Most guidelines for evidence-based practice use the acronym PICO (Population, Intervention, Comparison and Outcome)[9] to help practitioners develop a well-worded question to facilitate a search for evidence (Table 1). Therefore, owing to an emphasis placed on assessing the effectiveness of tailored text messages to enhance positive behavioural changes within ethnic patients with LTCs, this review used a mixed method approach to examine the use of the intervention. A demonstration of how the PICO tool was applied, is given in Table 1:

Table 1: Application of the PICO tool[9: p.29-30]

Population	Ethnic patients (including minorities within UK, European regions and USA)
Intervention	Tailored SMS
Comparison	Individuals who are not using the intervention (control group)
Outcome	Enhancing positive behavioural changes towards adherence to medical regime

Accordingly, the following literature question was put forward: 'How do tailored text messages enhance positive behavioural changes within ethnic minority patients with long-term conditions?' In addition, further sub-topics/questions were examined:

- The impact of tailored SMS on patients living with LTCs;
- How the experiences of this patient group differ in terms of cultural norms, customs and traditions, demographic factors e.g. gender, marital status;
- Whether the effects of behaviour change models used to aid in the enhancement of positive behavioural outcomes improved adherence.

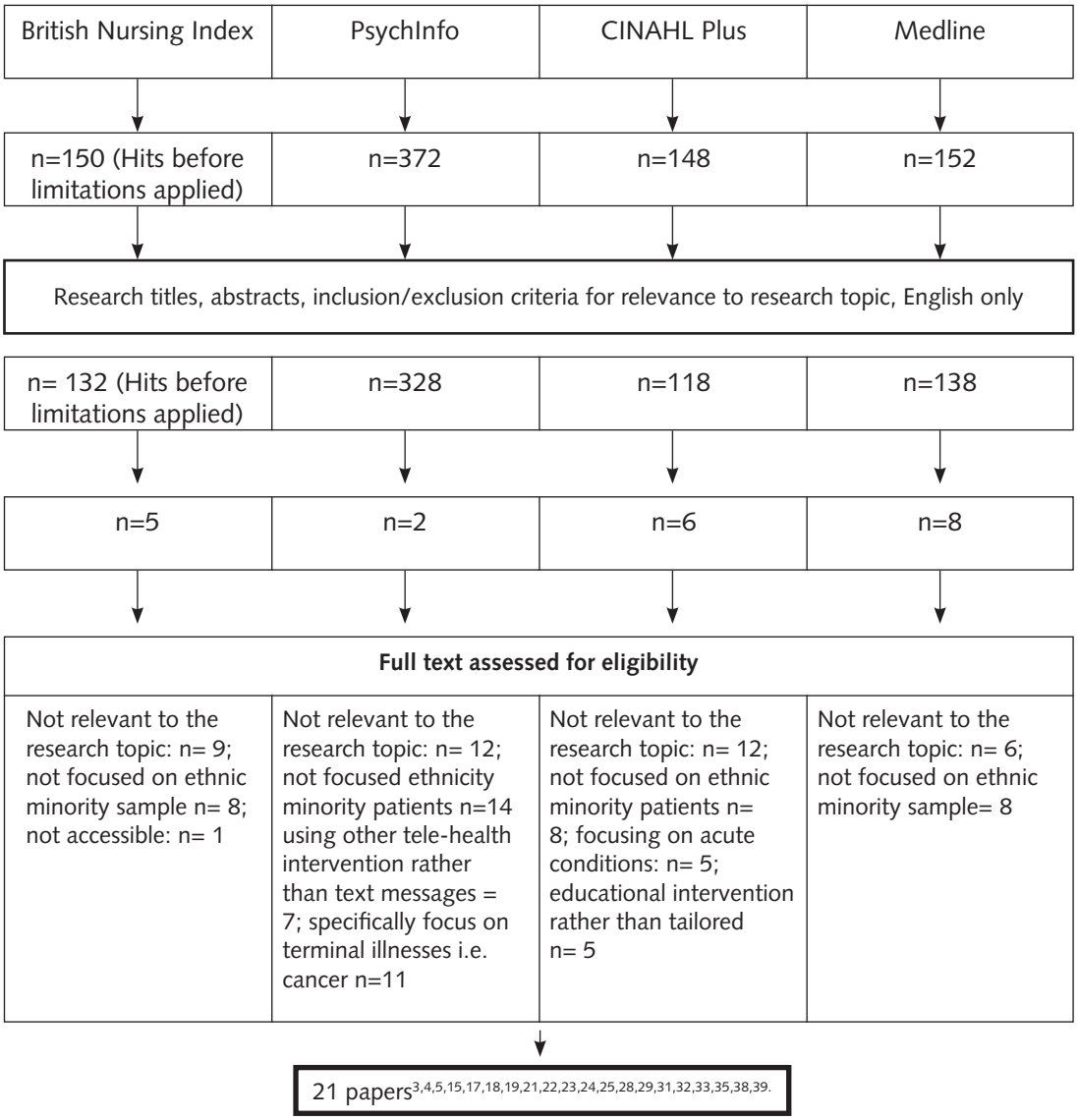
Search Strategy

A systematic search strategy using a range of databases (CINAHL, MEDLINE, British Nursing Index (ProQuest) and PSYCHINFO) were used to identify focused evidence-based literature

spanning the last ten years. Keywords from the PICO framework and common terms were entered in each of the databases used to yield papers. Terms were used in combination with 'Boolean operators', to expand or reduce search parameters resulting in a more focused and productive search[10]. The AND function was used to maximise search results by retrieving articles containing the relevant keywords, whilst truncations [*] were used to search for words with common stem also allowing words of variable endings[11].

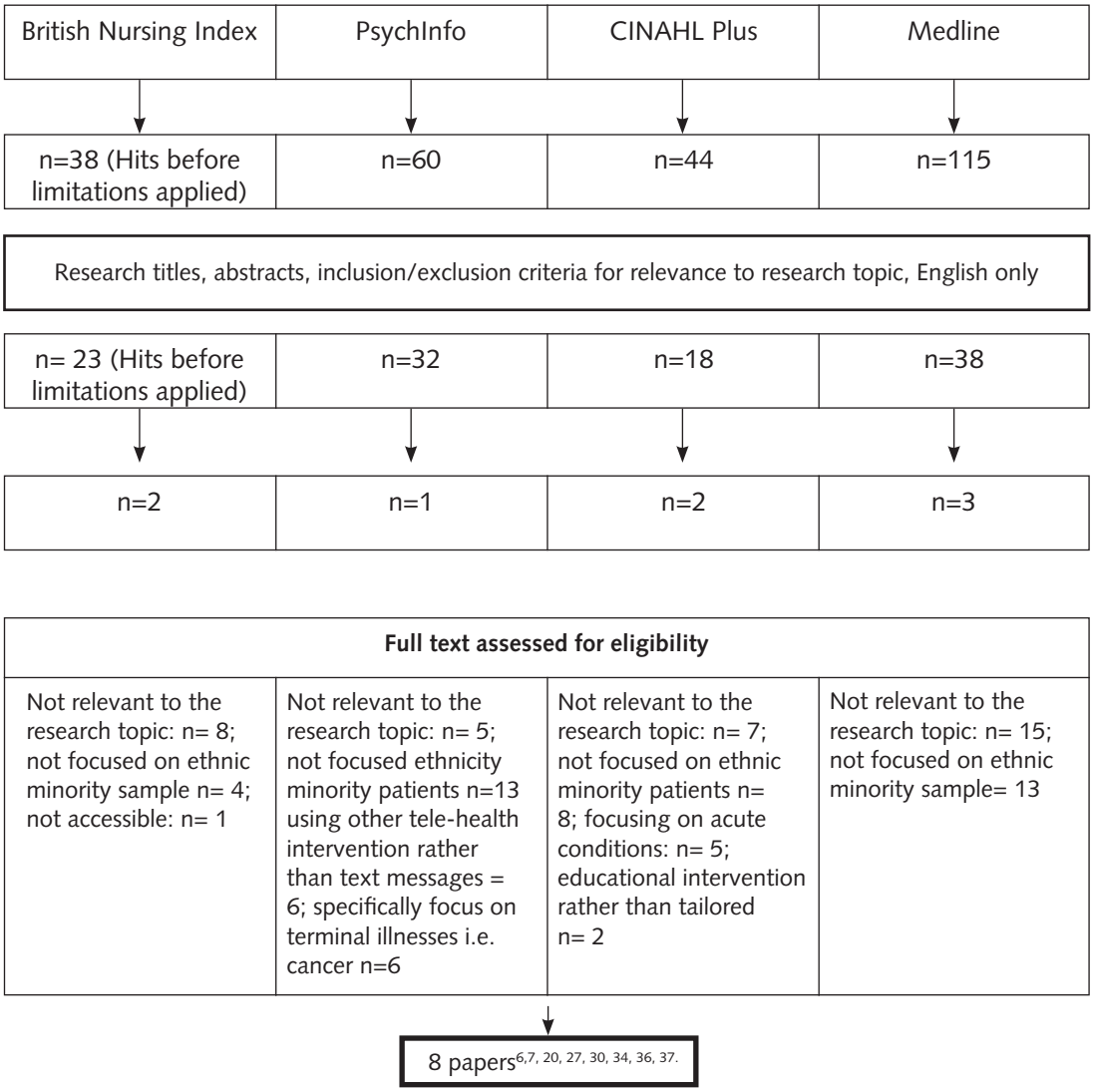
The initial search took place in 2016 (Diagram 1) and was rerun from 2016 to 2019, using the same search terms and journals shown above. Data from 2019 is presented in Diagram 2. Combining the two searches together, a total of 29 papers were collated.

Diagram 1: Flow diagram demonstrating the literature search process 1 (2010-2016).



REVIEWS FOUND= 0 retrieved on ethnic minority populations

Diagram 2: Flow diagram demonstrating the literature search process 2 (2016-2019)



Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were applied to ensure that only those papers relevant to the selected questions were included. Retrieval limitations were: studies within the last ten years; only peer-reviewed articles were considered to improve quality of research[11,12]; studies written in English language due to the time scale and cost issues associated with translation (Table 2).

No limitation was applied to country of study as this would limit the search. Only one study was found to originate within the UK regarding these population groups. The main focus of the research was on ethnic populations with LTCs, therefore, papers that were presented as dissertations, professional opinions or part of non-academic journals were not included. Other reasons for exclusion included recruitment of paediatric or adolescent samples and those with acute conditions or cancer, and studies focusing on general or Caucasian samples.

Table 2: Inclusion/Exclusion

Inclusion	Exclusion
• Published between 2006-2016 • Peer-reviewed • English Language • Adult patients; Ethnic minority populations • Patients with any long-term conditions, the most commonly considered included patients with diabetes, hypertension, long-term viral diseases such as HIV, and interventions tackling obesity i.e. increasing physical activity. Factors also associated with adherence and behavioural outcomes/ health management strategies • The use of tailored text messaging, SMS/short service messaging interventions	• Professional/ specialist opinion, Dissertation, Non-academic Journal i.e. Nursing times • Caucasian population from within Europe/ USA or Paediatric patients/adolescent • Patients with cancer and acute conditions; other conditions such as smoking cessation, non-chronic conditions • The use of other tele-health technologies/ interventions e.g. websites, phone calls, Video calls, emails etc.

The studies identified and discussed throughout the review, were critically appraised using the Critical Appraisal Skills Programme (CASP) tool, a well-recognised tool aimed to develop an evidence-based approach in health and social care, which assists individuals to analyse the best available research[13,14]. The CASP framework was used and adapted in line with the NICE (2016) methodology checklist, for a more focused critique of evidence based on this topic of interest

Overview of Papers Extracted

A total of 29 studies were retrieved and included; although the search encompassed ten years, the relevant papers included were published between 2010-2019. All the papers were research papers, six of which used a mixed method approach; seven studies used a qualitative approach and 16 studies that used a quantitative approach. Out of the 18 quantitative papers, two assessed the same intervention, which is the SMS-Text Adherence Support (Star) trial created to improve treatment adherence for hypertensive patients[5,15]. Six of the studies used a cross-sectional method by administering questionnaires and surveys for data collection; 15 studies utilised a randomized controlled trial design, and the remaining 12 used interviews as an exploratory method of data collection, particularly within the six qualitative studies found. In-depth interviews are the most common method of data collection in qualitative research encouraging participants to define important dimensions of a particular phenomenon[16]. Eleven studies were conducted in Asia; including one in Taiwan, three in India, one in Pakistan one in Iran, three in China and one in Malaysia. Six studies were conducted in African regions including two within Kenya, three in South-Africa and one in Cameroon. From the 29 studies, one also took place in the UK, one in Argentina and one in New Zealand. The remaining nine were performed in USA. Six studies report the time taken to complete the study; four took between 1-6 months and the remaining two lasted longer than a year, with the maximum being carried out for a year and six months.

Key Themes Extracted

From the 29 studies reviewed certain themes were identified and found to be pertinent to the self-management of LTCs, behavioural outcomes relating to health and the adoption of technology-based or text messaging interventions, utilised amongst ethnic groups. These are listed and discussed in greater detail below:

- Demographics (age, gender, education level, psycho-social factors)
- Barriers to Adherence
- Health Beliefs and Experiences
- Behavioural Goals, Psychological Affects and Outcomes
- Patient Education and Information Seeking
- Content Development of Text Messages

Demographics

Age and Gender

Demographic factors such as age and gender were addressed within all studies[28]. Four studies focused on female populations with LTCs and the use of a text messaging tool to enhance positive behavioural outcomes[17-20]. Gender differences were explored by Jennings *et al* (2013)[17], along with the development of a safe, comprehensive, and gender-tailored platform that would be acceptable for the participants under study. This study also addressed the challenges faced by women and their partners, in supporting the prevention of mother to child transmission of HIV. It also explored how mobile phones could be utilised to mitigate these challenges through gender-tailored messages. Male involvement reflected women's desires to address partner disclosure and to promote better partner support, suggesting that text message reminders can be seen as a useful channel to initiate a dialogue with male partners[17]. Both Steinberg *et al* (2014)[18] and Vakili *et al* (2015)[19] examined the use of text messaging to promote weight loss and healthier lifestyle choices in ethnic minority women. Findings were supportive of such intervention, suggesting mobile phones can be a useful self-monitoring tool for weight control and can improve healthy food choices. DeSouza *et al* (2014)[21] also examined a large proportion of participants from which they were able to identify certain gender differences existing within a typical Indian family, where women are often responsible for all household chores as well as the health and hygiene within their family. Women were also less likely to be employed making their schedules more flexible and conducive to ensuring better medication adherence in comparison to men. They were more likely to communicate directly with healthcare professionals regarding the management of health issues when assistance was needed. Although, valuable findings were retrieved gender differences were not explored in detail within other studies in relation to the views of living with a LTC and how the behaviours may vary between men and women[3,4,22].The literature presents findings that women's behaviour is associated with better health

outcomes compared to men, however it fails to acknowledge why men have poorer outcomes and are less adherent.

Similarly, age was another variable that was disclosed within the eligibility criteria, as all studies included adults aged 18 and above. Younger patients were found to be better engaged with the intervention within all the studies, due to having better knowledge and skills of using technology[23]. This suggests age contributes to engagement and acceptance of technology-based interventions, as older adults were seen as late adopters to mobile phone technology[23]. However, two studies specifically employed older samples to appropriately address the aims of their studies. Vakili *et al* (2015)[19], used a female sample aged between 40-60 years. Similarly, Müller *et al* (2016)[24], recruited subjects between the ages of 55-70. The two studies demonstrated text messages to be an acceptable platform to enhance positive life style changes, increasing exercise frequency and promoting healthier eating amongst participants[19,24]. Age was not seen to influence the use of text messages as seen in the Xiao *et al* study (2014)[23]. The older participants faced barriers due to not being able to read messages compared to the participants from the other two studies[19,24].

Education and Literacy levels

Education and level of literacy was found to be consistent with mobile phone use, positive behavioural outcomes, adherence and being able to read and understand text messages regarding treatment regimen in all studies. Educational text messages were designed and sent dependent on the condition patients presented. They were seen to be successfully aiding patients to adapt to positive lifestyle changes and improve compliance. However, variations were shown to exist between participants' education level, adherence levels and ability to use and understand texts sent to mobile phones. Eligible participants in some studies were those who were educated and able to read text messages, as they were seen to more likely respond to the intervention and self-manage their condition effectively. This was an important factor to consider by some researchers, as low literacy was shown to lead to rejection to text messages, poor self-management of LTCs and health outcomes in regions such as China, Africa, India and Pakistan[3,6,22,23,25,27]. Limitations of mobile phone communication included how to relay complex text messages and verifying that the recommended tasks given via text messages were completed. Participants who experienced difficulty with the intervention required support from their partners, families and health workers to help them read and understand what messages were telling them to do.

Text messages improved patient education, adherence to clinic visits and treatment of hypertension for all patients through additional educational messages, providing information on blood pressure control and adherence to antihypertensive medications[15]. Similarly, patients who were better educated acquired better self-management techniques through regular monitoring of blood sugars and attending clinics periodically when advised[22].

Region of residence was also found to affect literacy and education levels in some studies. South-Asian patients living within the rural regions of the continent had lower levels of education impacting

the domains of treatment, care and support they received, which in turn led to poor adherence, reduced benefits of treatment and limited therapeutic options[3,21]. In comparison, individuals in rural China, and those with less than a primary education found it difficult to read messages and were less willing to accept messages. Similar to the Asian populations, poor adherence existed within the Black African-American population, with lack of knowledge regarding self-management guidelines to effective glycaemic control being a major challenge[28]. Attention to factors such as English literacy and education within such samples would only serve to improve the efficacy of mHealth and aid in treatment adherence.

As a whole, in terms of patient education the mobile phone is a useful device delivering text messages to educate individuals from different countries of the world, along with motivating and prompting various self-care activities to improve self-management of LTCs[18,19,25,28,29,30,31].

Barriers to Regimen Adherence

Many barriers related to treatment adherence amongst ethnic groups were discovered, such as: communication issues, social issues (for example, costs of treatment), forgetfulness, lack of understanding or education on treatment regime, health beliefs related to taking medicine or adhering to healthy changes and views on side effects[3,4,25,30,32]. Forgetfulness was identified to be a recurring theme in many studies, where participants had a hard time remembering to take medication, which led to missing doses[5,23,25,28,29,33]. Therefore, mobile phones were utilised to provide tailored messages to inform patients of the benefits of improved adherence and to prompt and remind them to take medication to assist with self-management of various conditions[6,7,22,33,34], or to increase exercise frequency[18,24,35], promote screening of TB and HIV testing[3,27,36,37], and encourage healthy eating[19,39].

Reduced finances and social circumstances influenced regimen adherence within ethnic patient groups[17,20,25,28,30]. Despite the availability of effective treatment, many patients felt that inadequate resources and high costs of medications contributed to poor compliance[3,28,33]. Disadvantages for using mobile phones, to assist patients to take medications on time, included lack of sufficient funds for purchasing airtime or charging phones when multiple text messages were initiated[17].

Some studies also identified psychosocial components associated with medication adherence and desire for using text messages or mobile phones. Participants within the Leon *et al* (2015)[5] study described how the stressors of daily living made it difficult to adhere to treatment and adopt technology-based interventions, these included: poverty and material deprivation, emotional stress due to competing demands of care giving roles, bereavement, unemployment, living in fear and discomfort from perceived side effects and certain health beliefs about medications. Some of these findings were consistent with other studies, specifically where it was revealed that the most common challenges associated with medication adherence were fear of side effects, lack of social support, knowledge deficits and low self-efficacy[3,4,28,33].

Health Beliefs and Experiences

Health beliefs of the different participants within different regions have been shown to influence medication adherence and acceptance of mobile phones (and text messaging interventions) in various studies[5,23,25,33,36].

Patients believed that using mobile phones to aid in medications did not benefit their health but were rather harmful and unimportant[33]. Some also complained about the complexity of receiving messages and then having to adhere to information regarding diabetes care, which was found to influence and reflect upon patient beliefs about their self-management and acceptance of text messages[6]. However, some patients believed messages to be useful and helpful to follow through medications, foot care and appointment schedules[28]. Similarly, messages helped with adherence to HIV treatment which was experienced as a complex phenomenon amongst SA and Chinese participants due to complicated dosing, patient characteristics, healthcare systems, treatment regimen and environment[3,4].

Cultural beliefs have been found to affect patients' attitudes and beliefs about medical care, their understanding of managing and coping with the course of an illness, the meaning of a diagnosis, the consequences of the medical treatment and the acceptance of technology. People originating from South-Asian and Middle Eastern regions may believe illnesses to be the result of super-natural phenomena[3,19]. Pakistani participants regarded religion to be an important coping mechanism for their condition. They believe that turning to God for patience and strength enhanced their ability to cope with difficult diseases such as HIV rather than relying on a text-messaging system. Similarly, Vakili *et al* (2015)[19] identified the notion and importance of religion within the Iranian culture, where individuals dealt with complexities in life including those of disease through their faith in God rather than the benefits of medications or modern technology-based interventions (mobile phones). Cultural and religious aspects were seen to play a major role in patient compliance. Whilst, text messages within the interventions were designed in terms of the condition and translation of language, messages were not tailored to address cultural and religious needs, which were a vital aspect of daily life for many participants[3,7,19,21,23].

Disease burden also impacted health-related outcomes and acceptance of using mobile phones. This was evident in participants living with cardiovascular disease, who showed poor compliance to taking anti-hypertensives and not complying with messages sent to support their self-management. Patient attitudes were affected due to 'unfair labelling' as 'non-adherent'[15] when they were unable to keep up with their regime and the health messages delivered. This resulted in patients turning away and feeling less motivated towards text messages. This was also witnessed in HIV-related stigma in some studies, where participants felt ashamed and feared negative beliefs, feelings and attitudes from society[3,25]. Patients from African and Pakistani regions did not feel comfortable with text messages as they felt they were constantly being reminded of having the 'shameful' disease[3,25], instead they found it more important to keep their disease private as they feared being labelled and members of their community finding out. However, Xiao *et al* (2014)[23], identified regional

differences stating that participants living within rural areas had higher acceptance of the text-messaging intervention due to the disease being less stigmatized in comparison to urban regions. This suggests the importance of reputation and self-respect within certain cultures, as certain samples with the condition experienced loss of hope, reputation, and feelings of worthlessness, leading to poor self-management and adherence to text messages.

Behavioural Goals, Psychological Affects and Outcomes

Patient behaviour was seen to be the major cause of non-compliance to medication regimen[5,22,23,25]. This particularly included negative behaviours where some participants felt taking medication was a burden, and believed it not to be important, which accompanied feelings of laziness, tiredness and lack of motivation when engaging with the text messages. Others feared the side effects of medications and believed it to be harmful rather than helpful in the management of their condition[28,33], hence some patients ignored messages to avoid taking medications. Therefore, behaviour goals were seen as an imminent component influencing positive behavioural change in many studies[18,19,24,28,38,39]. A series of personalized behaviour change messages were sent to assess and ensure patients' goals were met in terms of their self-management and monitoring strategies. With regards to obesity, patients answered questions that determined their need and self-efficacy to change behaviours associated with weight management[18,38,39].

Participants described how major life stressors such as being involved in abusive relationships or undergoing a divorce were seen as the backdrop for readiness to change adherence behaviours[16]. These participants described how such events led to depression and acts of self-blame resulting in poor compliance to medication. For this reason, they felt that text messages had restored their confidence, 'nudged' them in the direction of better self-care and reinforced positive changes[5]. Findings demonstrate that there was a long-term impact for several subjects who report the SMS intervention being beneficial, and described their methods for organizing, routinising and sustaining their new and improved adherence behaviours[5].

Participants felt empowered by the prompts provided by text messages and improvement in adherence and attitudes towards self-monitoring behaviours[18]; they felt a greater sense of control and understanding of the seriousness of their disease, and the importance to make improvements to their health practices. They noted text messages to increase their awareness of taking more responsibility for managing their own health through regular self-monitoring which enhanced self-efficacy[5]. High self-efficacy impacted patient motivation in positive ways. Hence, text messages were used to motivate and encourage participants to adhere to behavioural goals[19,24,28]. Some participants affirmed the value of text messages, describing them as very important, encouraging and inspiring. Although, text messages have shown to have positive behavioural outcomes, in promoting high self-efficacy in many participants with LTCs, low self-efficacy was evident where samples experienced an incentive to learn more about their condition[21]. Patient education and information seeking were a vital component to improve adherence to regimen[5,17,22,37].

Patient Education and Information Seeking

Patient with LTCs confirmed that information and patient education increased their compliance with treatment[20,21,28,34,38]. Indeed, people managing LTCs reinforced that being knowledgeable about the disease and overseeing aspects of their treatment facilitated their survival, and also assisted in utilising text messages to aid with their self-management process[15,17,22].

Patients suggest that information and education assisted in the self-management of diabetes[28]. They found automated text messaging reminders to be a feasible and a useful means for improving self-management amongst varied diabetic racial groups. Participants emphasized that daily reminders helped them avoid missing their medications, to regularly check their feet for wounds and attending arranged appointments[6,20,22,28].

Educational texts motivated patients to collect and take medication as well as providing information regarding hypertension and its treatment[15]. Informative text messaging interventions can have positive effects such as aiding to prevent mother-to-child transmission of HIV[17]. Appropriate education informs the participants regarding specific services that would provide patients with extra drugs, information on early infant testing, as well as the benefits and risks of breastfeeding versus mixed feeding[17]. Some patients suggested education to be a continuous process providing opportunities to improve health outcomes[35]. Educational interventions can be useful to aid in improving self-monitoring and self-efficacy for individuals with LTCs; the information and support provided can lead to the development and implementation of a 'meaning-centred' philosophy[40]. To elaborate, this would facilitate comprehensive integrated primary care focusing on the delivery of personalised care, also identify and enhance patient knowledge in terms of their own information and educational needs, which in turn would support them to live an independent and fulfilling life[38,40].

Content Development of Text Messages

The content, comfort and timing of delivery of messages directly impacts behaviour of patients and influences their education and information needs. Participants experienced motivation and a greater sense of social connectedness. They valued the supportive content and polite tone of text messages, which appeared to have generated a sense of recognition, respect, value and care[16]. Messages were translated into the local languages of the region in which the studies were conducted to prevent language barriers; this was proven to be effective as participants were able to read, understand and follow messages[7,15,19,21,23,25]. Having a choice of languages for the SMS content was appreciated by some participants[5]. Patients felt the need of an intervention that would aid them and protect the family environment from the burdens of the disease[21]. Subsequently, they were permitted to specify additional messages that they believed would benefit them[33-35].

The content of messages from all studies provided information that was relevant to their illness, condition or current situation[17,28,33]. Most of them focused on the goal planning techniques for self-monitoring, repetition and substitution, social support and information on natural consequences

of LTCs[15,18,37,39]. For diabetic patients, texts were generated to help reduce barriers to medication adherence, to successfully promote self-management and care which aided with blood sugar monitoring reminders and foot care[22,28,33]. Similarly, for those participants living with hypertension and HIV, reminder messages were sent to take medications on time, information regarding blood pressure monitoring and prevention of HIV transmission was provided[5,15,23,25,29]. In some studies, participants felt comfortable using the technology, accessing and reading text messages with no technical difficulties when messages were received[5]; whereas, others reported difficulties or unease with the technology due to not being confident phone users, particularly older patients[5,32]. For this reason, participants were not able to engage with text messaging systems. Other reasons for not using such interventions was due to some individuals who found it inconvenient to receive SMS-messages when not given a choice to choose the timings of receiving messages, particularly during work[5,20]. Majority of those who were older participants, or men and women with lower literacy level who were not being able to read, suggested other platforms such as voice-mail, video-calls or telephone calls to be considered[5,6,23]. Such participants felt that these alternative interventions could allow for easy access to care where they could converse and receive detailed feedback from healthcare professionals regarding their treatment regimen and self-management goals.

It is important to ensure that information enables patients to maintain a sense of normality, through minimal disruption in maintaining factors most valuable to them such as their lifestyles and daily routines. For this reason, study subjects were given a preference of the frequency of text messaging delivery. Patients indicated that the timing of the text messages provided them the opportunity to change not only their adherence behaviour, but to also tackle their stressors more positively[16,38]. Receiving text messages everyday was most appropriate as it helped patients to remember taking medications on time and enabled behaviour change techniques to increase self-efficacy[25,34]. Those receiving texts every day felt they were well- looked after, and noticed improvements in their self-management regime and health outcomes[24,30,33]. However, male participants that were employed full-time preferred messages to be sent outside of working hours to prevent disturbances, compared to female samples that did not have a preference of timings due to being at home with a more flexible schedule[3,21]. Low adherence was evident in those participants who received three or fewer messages in a week. Non-adherent participants were not prompted as often and felt that in order to be successful in behavioural change, and improving effective treatment adherence daily text messages would be more useful[18,19].

DISCUSSION/CONCLUSION

This review intended to explore whether text messaging interventions enhance positive behavioural changes within ethnic minority patients with LTCs. It also investigated whether the intervention was of any benefit to ethnic groups in terms of providing support for adherence to treatment regimens and adapting to healthier lifestyles. Twenty-nine papers were included from which a number of broad themes and sub-themes have emerged that are important in the self-management of LTCs and use of text messaging in ethnic groups. Subsequently, seven prominent

topics were drawn out and scrutinised.

Although, interesting findings were obtained, some limitations were outlined during the review. Firstly, literature was prominently based on conditions such as HIV, hypertension, diabetes and obesity. Literature on illnesses such as CKD[1] and TB[1] was limited, whilst studies on others such as Arthritis, COPD, Alzheimer's, coronary heart disease, dementia, and stroke were not found. Further research is needed to examine and determine whether commonalities exist between population groups and their behavioural outcomes, towards the management of various long-term diseases. This may be particularly relevant to ethnic minority groups within the UK.

This review adds to knowledge in this area as several factors were discovered to be impactful towards the management of chronic diseases and acceptance of an SMS intervention. From the findings it appears that to improve compliance and acceptance of mobile health interventions it is important to improve text messages to better suit ethnic patients. Recommendations include: 1) the importance of text messages that are tailored and not too complex so that they can easily be followed ; 2) literacy and education levels need to be taken into account as one message type may not fit all; perhaps a prior sub-analysis can be performed to determine patient levels of knowledge and education to ensure they understand the information they are receiving; 3) messages should be frequent to prompt successful behavioural change and improve adherence; 4) health beliefs influence compliance to healthcare regimens and whether individuals took notice of messages, hence it is important to have an understanding of participants' culture and health beliefs before using such interventions.

With regard to cultural health beliefs, Osborn and Mulvaney (2013)[33], were able to establish key components that led to non-compliance such as 'stigma', which was also found in other studies[23,25], where patients felt ashamed of their condition and experienced loss of hope and reputation, particularly those living with HIV. This is an interesting factor leading to non-compliance when participant's coping mechanisms and cultural aspects encompassing this issue were not considered, as literature suggested the importance of reputation and self-respect in some cultures. Other factors identified to be important in certain cultures include gender roles highlighted by DeSouza *et al* (2014)[21], and the differences between males and females that exist within a traditional South-Asian household, where the male is usually the main breadwinner providing for the family and the female is consumed with household chores. In their study it was uncovered that women had better medication adherence, due to having a more flexible schedule in comparison to men. Although these findings are valuable, gender roles and differences in perception were not explored in-depth within different cultures in populations living with an LTC.

Professionals determine the content of patient education programmes including text messaging interventions for patients living with LTCs. If core elements hindering adherence behaviours can be identified for particular patients and patient groups at pertinent times, interventions can be targeted and be more effective based on the actual needs of patients. However, concepts such as 'tailored

messages' require a deeper appreciation and clarification. Each study aimed to design and structure text messaging interventions, to investigate their effects on acceptance and particularly to improve adherence, and enhance positive behaviours. However, often no explanation was offered to indicate the meaning of the word tailored or whether messages were created to address the individual needs of all patients. Nonetheless, messages were translated into the local languages, which itself is an element of tailoring the needs of patients, as they were given a preference to choose which language they preferred[15,19,38]. Patients faced difficulties and barriers that were identified with the interventions including factors such as: age, literacy levels and timings of certain messages along with certain content preferences. Patients also received generic informative text messages rather than them being 'individualised' or 'personalised', suggesting messages were not actually tailored in a way to address particular needs of the individual participants. It would appear that it might be most effective to determine what a patient knows, what is important for them and the type of information they would prefer to receive as an aid to improve adherence to medication regimen and for the enhancement of positive behavioural outcomes.

Therefore, further research is required to understand patient knowledge levels and to determine their perception of what a tailored intervention should be. Along with this, there is a need to understand the experiences of people from ethnic and minority groups to address these barriers when implementing prevention and support programmes aimed to facilitate the management of diseases[34].

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