

# Mobile Messaging and Behaviour Change

The effectiveness of mobile phone messaging in changing health behaviours and improving health outcomes



Over the past decade, the application of mobile technology in healthcare has drawn wide attention and has been commonly called mobile health or mHealth.

mHealth has been expanded from providing healthcare support (e.g. clinical decision support and electronic medical records) to health prevention, promotion, diagnosis, and monitoring (Ali et al. 2013). mHealth has particularly focused on chronic diseases such as cardiovascular disease (CVD) and has been widely considered an effective tool for chronic disease management (Chow et al. 2016).



## Mobile/digital messaging

More recently, there has been a growing appreciation for the use of mobile phone interventions to promote behaviour change, for example stopping smoking, reducing alcohol consumption, increasing levels of physical activity, reducing calorie intake, seeking antenatal care and adhering to medication. A popular mHealth intervention for health promotion is mobile messaging (or digital messaging, as it is increasingly being called).

Mobile messaging includes Short Message Service (SMS)/text messaging, Voice or Interactive Voice Recognition (IVR) messaging, instant messaging, and messaging and notifications through apps and websites.

Mobile messaging interventions are popular because they can deliver cost-effective, scalable, brief, real-time and tailored messages at moments when individuals need them most. They reduce time demands on both the individual and the healthcare practitioners. They maintain the privacy of the user.

**63%**

**of people worldwide  
own a mobile phone**

Mobile phones are a great way to engage with otherwise disengaged populations. With the majority of people (63%, according to Statista) worldwide owning a mobile phone, regardless of socio-economic status, there is an opportunity to reach hard-to-reach populations who have limited access to primary health care.

Mobile phones are increasingly becoming the dominant mode of communication among the younger generation in all countries. So mobile phone messaging is an effective way to engage with a generation of young adults who are otherwise switched off from traditional media.

## Mobile messaging and the developing world

In addition to the high burden of infectious diseases, the leading cause of death in low- and middle-income countries (LMIC) is non-communicable diseases, accounting for about 54 per cent of all deaths (Skolnik 2012). Self-care management and medication adherence are aspects of chronic disease management which will improve quality of life, health outcomes and cost-effective healthcare (Hamine et al. 2015). Typically, though, only 50 per cent of patients diagnosed with chronic diseases maintain chronic disease management regimes and the extent of non-compliance is even higher in developing countries (Hamine et al. 2015).

Additionally, the rates of maternal mortality, child mortality and HIV/AIDS are disproportionately higher in the developing world. Most of these deaths are preventable with greater access to information and healthcare. We also know that more households in developing countries own a mobile phone than have access to electricity or clean water, and nearly 70 per cent of the bottom fifth of the population in developing countries own a mobile phone (World Bank/IBRD 2016).

80%

**of women in LMIC  
own a mobile phone**

About 80 per cent of women across LMIC now own a mobile phone (GSMA 2019). So, there is an opportunity to reach hard-to-reach populations especially in low-resource settings in the developing world who have limited access to primary health care using mobile phones. The implementation of mHealth systems in this context could provide cost-effective delivery strategies for healthcare, bolster existing services and plug the gaps in information, access and quality of healthcare.

### Obstacles in implementation



Implementing mHealth interventions is not without obstacles, especially in the developing world. Some of these obstacles concern technological or infrastructural challenges such as poor access to network and/or electricity, malfunctioning phones, or a generally unreliable ICT environment.

It is important to understand the context of the setting. There may be high illiteracy rates, confidentiality issues due to phone sharing, or constant phone number changes. The audience may have poor motivation caused by low salaries, a lack of incentives or

high work pressure. Broader health system challenges may occur such as a shortage of adequately trained staff, and failure to integrate the new technology within existing systems of care (Krah and de Kriuf 2016). Much of the success of mHealth interventions, therefore, relies on an in-depth understanding of the context and the target audience.

**This white paper will explore and examine various aspects of mobile messaging that would have a bearing on their effectiveness in changing behaviour.**

## **Can mobile messaging change health behaviours?**

Overall, yes. A meta-analysis by Yang and Van Stee (2019) has shown that mHealth interventions have significantly improved health outcomes in relation to physical activity, diabetes management and antiretroviral therapy adherence.



**67%**

**of reviews concluded that SMS messages contributed to healthy behaviour**

A meta-analysis by Orr and King (2015) identified 40 reviews that addressed the use of SMS messages to enhance healthy behaviour. Overall, 67 per cent of reviews concluded that SMS messages contributed to healthy behaviour, 11 per cent concluded that it did not and 22 per cent withheld judgement on grounds of insufficient evidence.

These reviews suggest that SMS messages are most effective for relatively simple behaviour modification such as attending medical appointments (100% of studies reporting positive impact) and increasing medication adherence (85% of studies reporting positive impact). The impact of SMS messages on more complex health behaviour change was weaker. Only 68 per cent of studies showed a positive impact on the adoption of healthy lifestyle choices (such as smoking cessation or healthy diet). Only 50 per cent of studies showing positive impact on disease prevention activity (such as sunscreen use or immunisation).

A Mildon and Sellen (2017) study of mobile phone interventions for behaviour change communication came to a similar conclusion. It is likely that brief, standardized messaging services (using either short-message-service [SMS] for written text, or Interactive Voice Response [IVR]) will be more effective for episodic behaviours (such as attendance for ANC or immunization). Habitual practices with complex, socially-mediated determinants (such as exclusive breastfeeding) will require more intensive and multi-faceted behaviour change communication (BCC) interventions.

# Does message content and design matter?

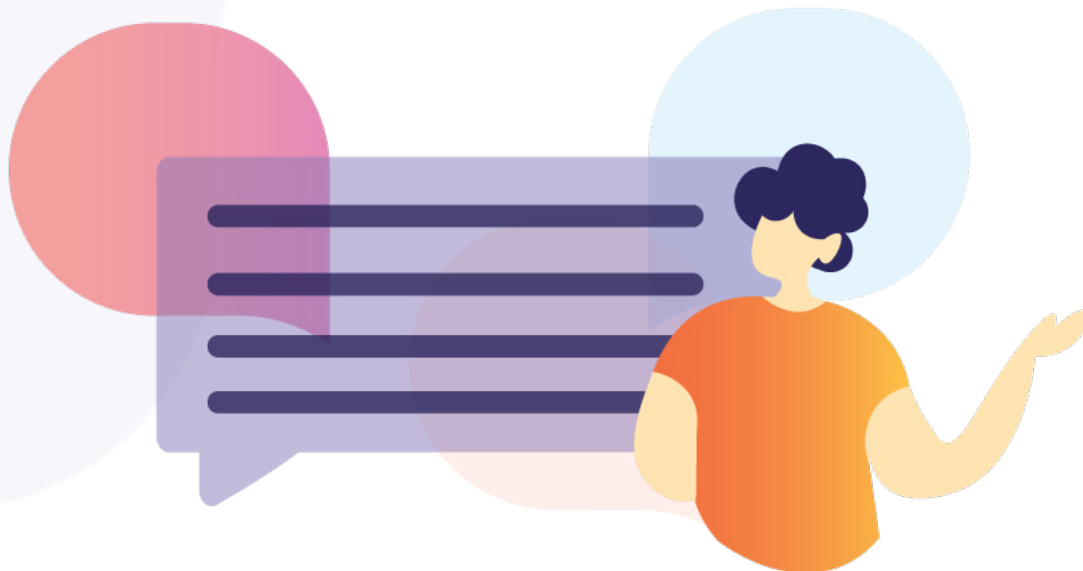
While we know that mobile phone interventions are effective in varying degrees in changing behaviours, what do we know about the actual messages in the programmes? How do we design messages for mobile phone interventions that result in behaviour change? Can we use behaviour change techniques in addition to information provision in order to engage, motivate and enable participants to adopt and sustain behaviours? To examine this, let us look at three aspects of messaging – content, tone and language, and then message frequency and dosage.

## 1. Message Content



### Messages based on theoretical constructs help sustain healthy behaviours

Behaviour change interventions grounded in theory demonstrate greater efficacy for producing health behaviour change compared to those that are not guided by theory (Michie and Johnston 2012; NICE 2007). This was corroborated by a more recent meta-analysis of the effectiveness of mobile phone interventions by Yang and Van Stee (2019) who found that mHealth interventions based on cognitive AND behavioural theories combined are more effective than interventions not indicating a theory or interventions applying behavioural theory only or cognitive theory only.



SMS messages provide an ideal vehicle for delivering content based on effective behaviour change theories such as the transtheoretical model (Prochaska et al. 1992), motivational interviewing (Miller and Rollnick 2002), social cognitive theory (Bandura 1989), self-determination theory (Deci and Ryan 1985), the theory of planned behaviour (Ajzen 1991)

and social ecological theory (Bronfenbrenner 1977) to initiate positive short-term health behaviour change.

Despite this, very few SMS interventions were based on a health behaviour theory (Abroms et al. 2012; Cole-Lewis and Kershaw 2010; Fjeldsoe et al. 2009).

### **Provide information about the health problem**

A review of behaviour change techniques employed by health interventions found that effective interventions gave users information about the health problem, the link between behaviour and health, causes and consequences and instruction on how to perform the behaviour (Briscoe and Aboud 2012). For example, interventions tackling malaria informed participants about the importance of keeping mosquitoes at bay and how to use bed nets appropriately (Alaii et al. 2003; Binka et al. 1996; Lindblade et al. 2004; Panter-Brick et al. 2006; Schellenberg et al. 1999). While this review focused on interventions that provided information orally and directly to the participants, we can apply the same principles for mHealth interventions where information is sent digitally.

### **Give advice and support, not just reminders**



A mobile messaging service that provides advice and support in addition to regular reminders is more effective than one that only sends reminders.

A mobile messaging project in Nigeria called HelloMama that sent SMS and voice messages to pregnant women, new mothers and household decision makers to improve maternal, newborn, and child health behaviours, used a behaviour change strategy that included providing advice, support and reinforcement messages in addition to regular reminders.

In addition to improvements in knowledge levels, there were increases in antenatal clinic attendance, application of chlorhexidine to the newborn stump, exclusive breastfeeding for the first 6 months of the baby's life and use of family planning method to space pregnancies (Pathfinder International 2019).

Similar mobile messaging projects in South Africa (MomConnect) and India (mMitra) have resulted in more antenatal visits, more vaginal births vs c-sections, less low birthweight babies, more timely initiation of complementary food for babies (6 months), more babies receiving all their recommended vaccinations, more HIV PCR testing of infants of HIV+ women within 6 weeks of birth and other improved maternal, newborn and child health practices (Murthy et al. 2019; Coleman et al. 2017).

**“Mobile messaging interventions are popular because they can deliver cost-effective, scalable, brief, real-time and tailored messages at moments when individuals need them most.”**

A randomised controlled trial conducted in New Zealand with 1705 smokers found that there was a higher quit rate among those receiving messages offering smoking cessation advice, support, and distraction (28%) compared to those who only received messages thanking them for participating in the study and reminding them to complete follow up (13%) (Rogers et al 2005).

The meta-analysis by Yang and Van Stee (2019) found that interventions that provided personalized reinforcement messages based on users' progress on health outcomes were effective.

## **Empowerment boosts health outcomes**

Programmes that have empowerment messages built into the programme are more effective than programmes that don't. Empowerment messages give the end-user the tools to carry out a certain behaviour, whether it is physical or mental. The meta-analysis by Yang and Van Stee (2019) found that interventions that change a person's personal environment by providing resources that immediately allow the user to engage in healthy behaviours are effective in improving health outcomes.

For example, an observational study conducted in 16 study clusters in Kenya found that by providing 474 village elders with weighing scales and mobile phones, the percentage of infants whose actual birth weight information was recorded increased from 43 per cent to 97 per cent. By providing the necessary tools, pregnancy case-finding and acquisition of birth weight information can be successfully shifted to the community level (Gisore et al. 2012).

## Motivational messages work

Studies have shown that interventions using motivational messages have a greater chance of changing behaviour compared with those that don't. A study of 5800 smokers conducted in the UK found that those receiving motivational and behaviour change messages had higher rates of abstinence than those receiving non-motivational messages. 11 per cent of the intervention group hadn't smoked after six weeks, compared with 4 per cent of the control group (Free et al. 2011).

Studies have also shown that utilizing motivational messages can encourage participants to read subsequent messages. A qualitative study was conducted in 17 government health centres in Kenya investigating the perceptions and experiences of health workers receiving text messages on paediatric outpatient malaria case-management accompanied by "motivating" quotes. The study found that proverbs in the messages encouraged participants (health workers) to read the next message (Jones et al. 2012).

**"Mobile messaging needs to employ a more nuanced messaging strategy or a more multifaceted behaviour change communication strategy to encourage complex behaviours."**

## Set goals for success

A review of 13 interventions promoting smoking cessation, healthy eating and/or physical activity targeted at low-income groups found that setting goals may help people to take steps to change their behaviour by making them more aware of it. Smaller, shorter-term goals also allow people to build on small successes (Michie et al. 2009).

## Provide prompts and cues to act

Messages that provide prompts or cues to act can be effective in eliciting desired behaviour. The Briscoe and Aboud (2012) review of behaviour change techniques employed by health interventions also found that all the handwashing and infant feeding interventions included in the review employed the technique of identifying and providing cues to action, such as time of day or preceding activities or the child's signals (Curtis et al. 2001; Luby et al. 2001, 2010; Monte et al. 1997; Aboud et al. 2009).

## Solve problems affecting behaviour

This involves identifying the facilitators of the desired behaviour, the internal and external barriers to performing the behaviour and the solutions to overcome the barriers. A review of behaviour change techniques employed by health interventions found that handwashing and infant feeding interventions included in the review used this technique



to encourage behaviour. For example, participants who said they did not have sufficient water for washing were shown how water could be reused, and care givers were helped to try different solutions to overcome children's refusal of food and to purchase inexpensive food (Monte et al. 1997; Lynch et al. 1994; West et al. 1995; Bhandari et al. 2004; Aboud et al. 2009).



### **Messages that engage users keep them interested**

Fjeldsoe et al. (2009) reviewed 14 studies on the effectiveness of SMS messaging in smoking cessation interventions and diabetes management interventions. 13 of the 14 studies had positive behaviour change outcomes. Tailoring of SMS content and interactivity were found to be important features of SMS-delivered interventions.

### **Messages using multiple techniques work better**

The use of behaviour change techniques such as goal setting, providing prompts and problem solving in health messaging are known to have some effect in encouraging behaviour change. In addition to this, Briscoe and Aboud (2012)'s review found that the most successful interventions used three or even four categories of techniques, engaging participants at the behavioural, social, sensory, and cognitive levels.

## **2. Tone and Language**



### **Tone and language matter**

A study examining messaging preferences in goal-directed SMS programmes found 75 per cent of subjects preferred certain types of messages. Key elements were grammatically

correct, free of textese, benefit-oriented, polite, nonaggressive, and directive as opposed to passive, among others. Subtle manipulations of message structure, such as changing “Try to...” to “You may want to try to...” affected message choice (Muench et al 2014).

### **Personalised messages are effective**

A study of 5800 smokers found that those receiving personalised messages based on their needs had higher rates of abstinence than those receiving automated messages. For example, by texting the word “crave”, participants with cigarette cravings would receive instant messages to distract and support them during their episode of craving. By texting the word “lapse” participants would receive text messages that encouraged them to continue with attempt to quit smoking. 11 per cent of the intervention group hadn’t smoked after six weeks, compared with 4 per cent of the control group (Free et al. 2011).

### **Empathetic messages are better than fear-based message**

Shen et al. (2011) investigated the effectiveness of fear- versus empathy-arousing anti-smoking Public Service Announcements (PSAs). Twelve PSAs were used and were based on empathy or fear. 260 participants were randomly assigned to each message type and watched PSAs presented in a random sequence. Results showed that empathy-arousing messages are potentially more effective than fear-arousing ones.

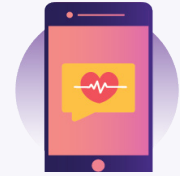
### **Use gain-framed messages to encourage prevention behaviours**

A meta-analysis of 94 peer-reviewed published studies compared the persuasive impact of gain and loss-framed messages. Gain-framed messages were more likely than loss-framed messages to encourage prevention behaviours, particularly for skin cancer prevention, smoking cessation, and physical activity (Gallagher and Updegraff 2012).



### 3. Message frequency and dosage

---



#### **Greater frequency of messages works better**

Orr and King's (2015) meta-analysis of SMS interventions found that studies using multiple SMS messages per day had a significantly greater effect on health behaviour change than those using lower SMS message frequency.

#### **Self-management messages are best daily**

In two studies (Whittaker et al. 2012; Arora et al. 2013) respondents preferred self-management messages (where every message is different) to be daily for a general health programme and also specifically for a diabetes management programme. In Whittaker et al (2012) the largest proportion of respondents selected one text message per day (42%), with the remainder evenly spread either side of this (less than one per day: 28%; 2–5 per day: 20%; more than 5 per day: 9%) for the optimal frequency of text messages. Daily messages have also been shown to work better in two RCTs looking at smoking cessation rates (Rogers et al, 2005; Bramley et al, 2005) as well as shown in a literature review looking at daily messages for weight loss (Shaw and Bosworth 2012).

#### **Reminder messages are best weekly**

A study in California examining a mobile health intervention to support patients with diabetes (Arora et al. 2013) also measured satisfaction levels of the recipients. With regard to medication reminder messages (where every message is the same), most participants (76.6%) found weekly reminders 'about right'.

#### **Timely messages that walk the journey of the recipient work**

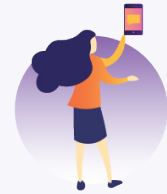
Regular messages (SMS or Voice messages) reaching pregnant women and new mothers weekly or twice a week during their pregnancy or parenting journey have been found to have resulted in more antenatal visits, more vaginal births vs c-sections, less low birthweight babies, more timely initiation of complementary food for babies (6 months), more babies receiving all their recommended vaccinations, more HIV PCR testing of infants of HIV+ women within 6 weeks of birth and other improved maternal, newborn and child health practices (Pathfinder International 2019; Murthy et al. 2019; Coleman et al. 2017).

Rogers et al. (2005) studied young smokers in New Zealand who joined a smoking cessation programme. Those who also received regular personalised text messages providing smoking cessation advice, support and distraction starting on the quit day were more likely to have quit smoking 6 weeks into the programme, compared to those who did not receive text messages.

## Regular messaging for at least 6 months increases knowledge levels

Choudhury (2015) evaluated the MAMA maternal and child health messaging programme in Bangladesh (Aponjon). He found that at least 6 months of use of Aponjon during pregnancy was twice more effective in increasing maternal health knowledge and practice compared to 3-5 months of use.

## Conclusion



Mobile health (mHealth) interventions play a significant role in filling gaps in access, coverage and quality of health services. At the same time, through mobile messaging, mHealth interventions can reach users with vital information and support which will help in increasing the demand for better health. So mHealth is particularly relevant in the developing world.

**“The evidence has shown that mobile messaging interventions have largely found acceptance amongst users, with SMS being the most popular choice.”**

Experts have also cautioned against the use of any channel of delivery without properly studying the context and assessing the appropriateness of one channel over another against the needs and practices of the target audience as well as programme goals.

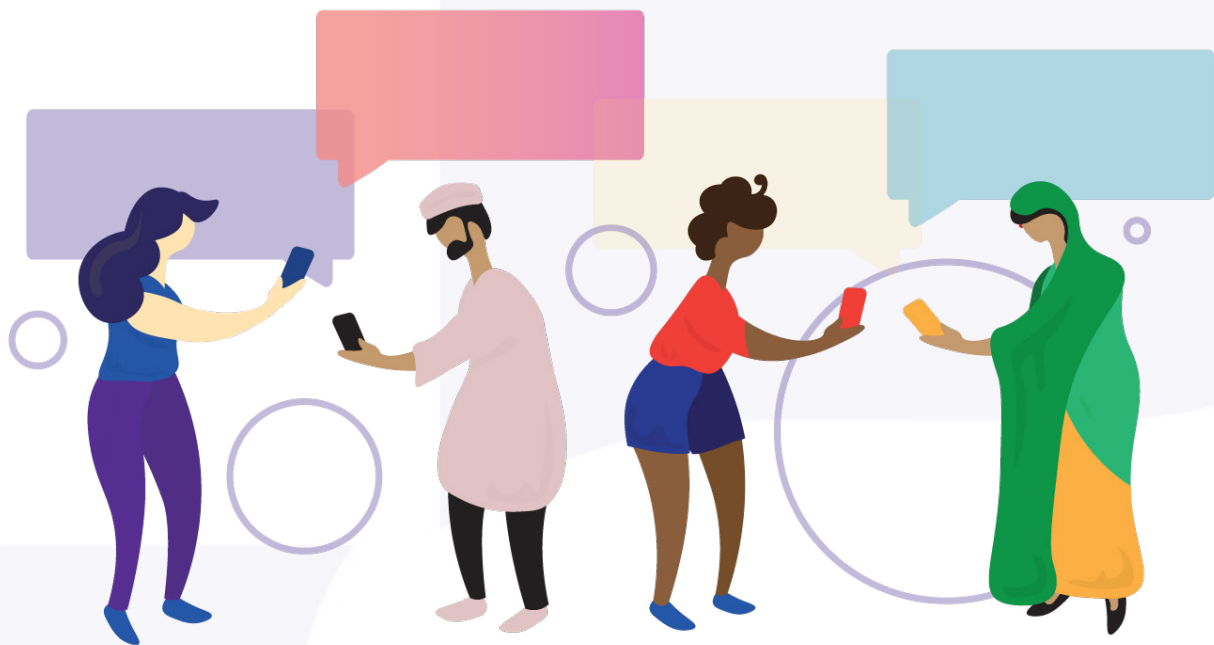
The qualitative study of the MomConnect programme in South Africa found that women were so enthusiastic about the messages and the information in them that many saved them to use as a resource or to share with others. This illustrates the value placed on the content of mobile messages, in addition to the medium of delivery. It also highlights the role ‘content’ can play in acceptance of mHealth interventions and, consequently, in behaviour change

There is significant evidence to show that mobile messaging can improve health behaviours, particularly the more simple, episodic behaviours such as clinic attendance, immunisation and medication adherence. The evidence is slightly weaker for more complex behaviours such as exclusive breastfeeding and smoking cessation. This necessitates the question can mobile messaging employ a more nuanced messaging strategy or a more multifaceted behaviour change communication strategy to encourage complex behaviours?

This white paper has outlined some of the tools and techniques that mobile messaging can employ in terms of message content, tone and language, and message frequency and dosage, drawing from behavioural science and other health communication research. In addition to looking at what has worked in other mHealth programmes, we have also

drawn inspiration from the more traditional health communication programmes and applied it to mobile messaging.

The success of a mobile messaging programme also depends on how aligned it is to the needs of the audience. This requires an in-depth understanding of the audience, their needs, gaps in knowledge, attitudes, behaviours and practices, and their appetite for digital solutions. This would mean that the target audience as well as key stakeholders must play a role in the design and development of the messaging strategy as well as the messages.



This white paper largely focuses on the mHealth interventions in the developing world. The use of smartphones and apps is still growing here, while they are widely used in the developed world. The developed world is witnessing a move towards patient-centred health and the digitalisation of the human body with wearable technology and apps. Individuals can make health decisions based on the information provided by these devices about themselves. In this scenario, the way consumers in the developed world engage with their smartphones and digital health apps would be an interesting area of further study.



## Gayatri Koshy

Gayatri Koshy is Head of mHealth for Thrive: Words that Change Lives. She provides behaviour change communication expertise to Thrive's digital health projects. With a Master of Public Health (MPH) degree, she has extensive experience working in global health projects as well as national level programmes such as India's National AIDS Control Programme.

At Thrive, Gayatri led the content development for the mMitra programme in India which now reaches over 2 million women in urban slums with audio messages on maternal and child health. She also worked on digital messaging programmes in China, South Africa, Nigeria and on a behaviour change programme for the mental wellbeing of university students in the UK. She has an interest in truly understanding communities and developing behaviour change communication strategies that work for them.

Gayatri says: "Thrive has reached millions of people globally with over 7000 health and behaviour change messages with proven results. The key to our success in driving impact is our ability to craft empowering and emotionally supportive content that connects with our audience at all levels."

To discuss how mobile messaging can be used to promote behaviour change in your audience, please contact Gayatri at [gayatrikoshy@thriveagency.uk](mailto:gayatrikoshy@thriveagency.uk)

## References

About FE et al. (2009) A responsive feeding intervention increases children's self-feeding and maternal responsiveness but not weight gain. *Journal of Nutrition*, 139: 1738-1743.

Abroms LC, Padmanabhan N and Evans WD (2012). Mobile phones for health communication to promote behaviour change. In S. M. Noar & N. Harrington (Eds.), *eHealth applications: Promising strategies for health behavior change* (pp. 147–166). New York, NY: Routledge

Adobe's report into the UK's content consumption habits, polling 1,000 UK consumers, <https://blogs.adobe.com/digitaleurope/digital-marketing/adobe-experience-manager-6-4-defining-the-next-wave-of-content-driven-experiences/>

Ajzen I (1991) The theory of planned behavior is alive and well, and not ready to retire: A commentary on Sniehotta, Preseau, and Araújo-Soares. *Health Psychology Review*. Advance online publication. doi:10.1080/17437199.2014.883474

Ajzen I (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211. doi:10.1016/0749-5978(91)90020-t

Alaii et al. (2003) Factors affecting use of permethrin-treated bed nets during a randomized controlled trial in Western Kenya. *American Journal of Tropical Medicine & Hygiene*, 68: 137-141

Ali EE et al (2016) Evolution and current status of m-Health research: A systematic review. *BMJ Innov* 2016;2:33–40.

Arora et al. (2013). Trial to Examine Text Message- based mHealth in Emergency Department Patients with Diabetes (TEXT-MED): A Randomised Controlled Trial. *Annals of Emergency Medicine Online*

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44, 1175–1184. doi:10.1037//0003-066x.44.9.1175

Bhandari N et al. (2004) An educational intervention to promote appropriate complementary feeding practices and physical growth in infants and young children in rural Haryana, India. *Journal of Nutrition*, 134: 2342-2348.

Binka et al. (1996) Impact of permethrin impregnated bed nets on child mortality in Kassena-Nankana district, Ghana: a randomized controlled trial. *Tropical Medicine and International Health*, 1: 147-154.

Bramley et al. (2005). Smoking cessation using mobile phone text messaging is as effective in Maori as non-Maori. *New Zealand Medical Journal* 118 (1216).

Briscoe C and About (2012) Behaviour change communication targeting four health behaviours in developing countries: A review of change techniques. *Social Science & Medicine*, 75(4): 612-621. <https://doi.org/10.1016/j.socscimed.2012.03.016>

Bronfenbrenner U (1977). Toward an experimental ecology of human development. *American Psychologist*, 32, 513–531. doi:10.1037/0003-066x.32.7.513

Carrasco MP, Salvador CH, Sagredo PG, Márquez-Montes J, González de Mingo MA, et al. (2008) Impact of patient-general practitioner short-messages-based interaction on the control of hypertension in a follow-up service for low-to-medium risk hypertensive patients: a randomized controlled trial. *IEEE transactions on information technology in biomedicine: a publication of the IEEE Engineering in Medicine and Biology Society*. pp. 780–791

Chande R et al. (2017) Increasing attendance and attainment among adult students in the UK: Evidence from a field experiment. Working Paper. <http://38r8om2xjhh125mw24492dir.wpengine.netdna-cdn.com/wp-content/uploads/2017/04/ALERT-working-paper-2017.pdf>

Chow CK, Ariyaratna N, Islam SMS, et al. (2016) m-Health in cardiovascular health care. *Heart Lung Circ*. 25:802–807

Chowdhury ME et al. (2015) What is the minimum exposure to mobile messaging needed to improve maternal and newborn health knowledge, practices and demand for services in Bangladesh? Presentation for GMNHC, Mexico City, 18-21 October 2015; <https://cdn2.sph.harvard.edu/wp-content/uploads/sites/32/2015/12/Mahbub-Elahi-Chowdhury.pdf>

Cole-Lewis H and T Kershaw (2010). Text messaging as a tool for behavior change in disease prevention and management. *Epidemiologic Reviews*, 32, 56–69. doi:10.1093/epirev/mxq004

Coleman et al (2017). Effectiveness of an SMS-based maternal mHealth intervention to improve clinical outcomes of HIV-positive pregnant women. *AIDS care* 29(7): 890-897. <https://www.ncbi.nlm.nih.gov/pubmed/28107805>

Curtis V et al. (2001) Evidence of behaviour change following a hygiene promotion programme in Burkina Faso. *Bulletin of the World Health Organization*, 79: 518-527.

DeBerard, MS et al. (2004) Predictors Of Academic Achievement and Retention among College Freshmen: A Longitudinal Study." *College Student Journal* 38 (1): 66-80.

Deci EL and Ryan RM (1985). *Intrinsic motivation and self-determination in human behaviour*. New York, NY: Plenum

Fjeldsoe, B. S., Marshall, A. L., & Miller, Y. D. (2009). Behavior change interventions delivered by mobile telephone short-message service. *American Journal of Preventive Medicine*, 36, 165–173. doi:10.1016/j.amepre.2008.09.040

Free C, Phillips G, Watson L, Galli L, Felix L, et al. (2013) The Effectiveness of Mobile-Health Technologies to Improve Health Care Service Delivery Processes: A Systematic Review and Meta-Analysis. *PLoS Med* 10(1): e1001363. doi:10.1371/journal.pmed.1001363

Free et al (2011). Smoking cessation support delivered via mobile phone text messaging (txt2stop): a single-blind, randomised trial. *The Lancet* 378: 9785 49-55 : [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(11\)60701-0/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(11)60701-0/fulltext)



Gallagher & Updegaff (2012). Health message framing effects on attitudes, intentions, and behaviour: a meta-analytic review. *Ann Behav Med.* 46 (1). <http://www.ncbi.nlm.nih.gov/pubmed/21993844>

Gisore et al (2012). Community based weighing of newborns and use of mobile phones by village elders in rural settings in Kenya: a decentralised approach to health care provision *BMC Pregnancy and Childbirth* 12:15. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3344691/pdf/1471-2393-12-15.pdf>

GSMA (2019) *Connected Women: The Mobile Gender Gap Report 2019*.

Hamine S, Gerth-Guyette E, Faulx D, Green BB, Ginsburg AS (2015) Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review. *J Med Internet Res.* 2015 Feb 24; 17(2):e52.

Hanauer DA, Wentzell K, Laffel N, Laffel LM (2009) Computerized Automated Reminder Diabetes System (CARDS): e-mail and SMS cell phone text messaging reminders to support diabetes management. *Diabetes Technol Ther* 11: 99–106.

Hurt K et al. (2016) mHealth Interventions in Low and Middle-Income Countries: A Systematic Review. *Glob J Health Sci.* 8(9): 183–193. doi: 10.5539/gjhs.v8n9p183

Jones et al (2012). “Even if You Know Everything You Can Forget”: Health Worker Perceptions of Mobile Phone Text-Messaging to Improve Malaria Case-Management in Kenya. *PLoS ONE* 7(6) <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0038636>

Krah EFM and JG de Kruif (2016) Exploring the ambivalent evidence base of mobile health (mHealth): A systematic literature review on the use of mobile phones for the improvement of community health in Africa. *Digital Health* Volume 2: 1–20

Lindblade et al. (2004) Sustainability of reductions in malaria transmission and infant mortality in Western Kenya with use of insecticide-treated bed nets: 4 to 6 years of follow-up. *Journal of the American Medical Association*, 291:2571-2580

Luby SP et al. (2001) Microbiologic effectiveness of hand washing with soap in an urban squatter settlement, Karachi, Pakistan. *Epidemiology of Infection*, 127:237-244.

Luby SP et al. (2010) A community-randomised controlled trial promoting waterless hand sanitizer and handwashing with soap, Dhaka, Bangladesh. *Tropical Medicine and International Health*, 15 (2010), pp. 1508-1516.

Lynch M et al. (1994) Testing a participatory strategy to change hygiene behaviour: face washing in central Tanzania. *Royal Society of Tropical Medicine and Hygiene*, 88: 513-517.

MEASURE Evaluation SIFSA (2015) mHealth for Behavior Change Communication Brief: Why mHealth messaging? <https://www.measureevaluation.org/resources/publications/fs-15-149>

Michie S and M Johnston (2012). *Theories and techniques of behaviour change: developing a cumulative*

science of behaviour change. *Health Psychology Review*, 6(1), 1-6. DOI: 10.1080/17437199.2012.654964

Michie S, N Hyder, A Walia and R West (2009). Smoking cessation services: Understanding their content and impact. *PSYCHOLOGY & HEALTH* 24

Michie S. et al. (2009) Low-income groups and behaviour change interventions: a review of intervention content, effectiveness and theoretical frameworks. *J Epidemiol Community Health* 2009;63:610–622. doi:10.1136/jech.2008.078725. <https://pdfs.semanticscholar.org/8108/1d003e6894c013770557dd47dcf984d36424.pdf>

Mildon A and D Sellen (2017) Use of mobile phones for behavior change communication to improve maternal, newborn and child health: a scoping review. *Journal of Global Health*. <http://www.jogh.org/documents/issue201902/jogh-09-020425.htm#R65>

Miller WR and S Rollnick (2002). *Motivational interviewing: Preparing people to change*. New York, NY: Guilford Press

Monte CMG et al. (1997) Designing educational messages to improve weaning food hygiene practices of families living in poverty. *Social Science & Medicine*, 44: 1453-1464.

Muench et al. (2014) Understanding Messaging Preferences to Inform Development of Mobile Goal-Directed Behavioral Interventions. *Journal Med Internet Res* 16 (2) <http://www.jmir.org/2014/2/e14/>

NICE (2007) Behaviour change: general approaches. <https://www.nice.org.uk/guidance/PH6>

Nirmala Murthy et. al. (2019) Impact of mHealth message service (mMitra) on maternal health of women from low income group in India: Findings from a Randomized control trial. *Maternal and Child Health Journal*. <https://doi.org/10.1007/s10995-019-02805-5>

NUS [National Union of Students], 2015. Mental health poll, available at: <http://appg-students.org.uk/wp-content/uploads/2016/03/Mental-Health-Poll-November-15-Summary.pdf>

Ofcom (2015) The Communications Market Report, 2015. [https://www.ofcom.org.uk/\\_\\_\\_data/assets/pdf\\_file/0022/20668/cmr\\_uk\\_2015.pdf](https://www.ofcom.org.uk/___data/assets/pdf_file/0022/20668/cmr_uk_2015.pdf)

Orr JA and King RJ. (2015) Mobile phone SMS messages can enhance healthy behaviour: a meta-analysis of randomised controlled trials. *Health psychology review*, 1-36. <https://www.tandfonline.com/doi/full/10.1080/17437199.2015.1022847>.

Panter-Brick C et al (2006) Culturally compelling strategies for behaviour change: a social ecology model and case study in malaria prevention. *Social Science & Medicine*, 62: 2810-2825.

Pathfinder International (2019) Evaluating the effectiveness and acceptability of using stage and age-based SMS and voice messaging to improve maternal, newborn, and child health knowledge, uptake of services, and satisfaction in Cross River and Ebonyi states of Nigeria. USAID.

Prabhakaran L, Chee WY, Chua KC, Abisheganaden J, Wong WM (2010) The use of text messaging to improve asthma control: a pilot study using the mobile phone short messaging service (SMS). *Journal of Telemedicine and Telecare* 16: 286–290.

Prochaska JO, DiClemente CC and Norcross JC (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist*, 47, 1102–1114. doi:10.1037/0003-066x.47.9.1102

Rogers et al (2005). Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging *Tobacco Control* 14. <http://tobaccocontrol.bmj.com/content/14/4/255.full.pdf+html>

Schellenberg et al. (1999) KINET: a social marketing programme of treated nets and net treatment for malaria control in Tanzania, with evaluation of child health and long-term survival. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 93: 225-231.

Schneiderman N, Gail Ironson, and Scott D. Siegel (2005) STRESS AND HEALTH: Psychological, Behavioral, and Biological Determinants, *Annu Rev Clin Psychol.* 2005; 1: 607–628. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2568977/>

Shaw & Bosworth (2012). Short Message Service (SMS) text messaging as an intervention for weight loss: a literature review. *Health Informatics Journal* 18: 235

Shen et al. (2011). The Effectiveness of Empathy- Versus Fear-Arousing Antismoking PSAs. *Health Communication* 26 (5). <http://www.tandfonline.com/doi/abs/10.1080/10410236.2011.552480#.U0-lsvldVyU>

Skinner D. et al (2018) User assessments and the use of information from MomConnect, a mobile phone text-based information service, by pregnant women and new mothers in South Africa. *BMJ Global Health* 2018;3:e000561. [http://gh.bmj.com/content/3/Suppl\\_2/e000561.info](http://gh.bmj.com/content/3/Suppl_2/e000561.info)

Skolnik R (2012). *Global Health*. 2nd ed. Vol. 101. Burlington, MA: Jones Bartlett Learning, LLC.

Statista “Number of mobile phone users worldwide from 2013 to 2019 (in billions)”, <https://www.statista.com/statistics/274774/forecast-of-mobile-phone-users-worldwide/>

West S et al. (1995) Impact of face-washing on trachoma in Kongwa, Tanzania. *The Lancet*, 345: 155-158.

Whittaker et al. (2012). A Development and Evaluation Process for mHealth Interventions; Examples from New Zealand. *Journal of Health Communications* 17

World Bank/IBRD 2016) *World Development Report 2016: Digital Dividends*. <http://documents.worldbank.org/curated/en/961621467994698644/pdf/102724-WDR-WDR2016Overview-ENGLISH-WebResBox-394840B-OUO-9.pdf>.

Yang Q and SK Van Stee (2019) The Comparative Effectiveness of Mobile Phone Interventions in Improving Health Outcomes: Meta-Analytic Review. *JMIR Mhealth Uhealth* 7(4): e11244. doi: 10.2196/11244.