Literature review on the effectiveness of online and mobile technologies for changing health behaviours

Prepared for Agencies for Nutrition Action

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Contents

1. Introduction

1.1 Background

In the decades since the arrival of the personal computer in the late 1970s, computing, information and communication technologies have changed dramatically. Bulky, slow computers have been replaced by portable computing devices that can complete increasingly complex tasks in less and less time. Landline phones have been replaced by mobile phones and other mobile devices that can connect people anywhere, anytime, and transmit text messages, photographs and data. The Internet has become a global phenomenon and, increasingly, static "Web 1.0" websites are being replaced by dynamic, interactive and collaborative "Web 2.0" platforms.

Advances in the capabilities of online and mobile technologies, combined with exponential growth in their use, provide a range of new and innovative opportunities for health promotion and behaviour change.

1.2 Review purpose and questions

The purpose of this literature review is to review the effectiveness of online and mobile technologies for changing health behaviours. In this report, 'online and mobile technologies' refers to the Internet, mobile devices, and interactive technologies accessed via the Internet and mobile devices (websites, blogs, social networking sites, email and text messaging).

The review addresses five key questions:

1. What are the key benefits of using online and mobile technologies to promote health behaviours?
2. Are online and mobile technologies effective for changing health behaviours?
3. Are online and mobile technologies effective for achieving sustained changes in health behaviours?
4. Are online and mobile technologies a cost-effective way of changing health behaviours?
5. Which features of online and mobile technologies are most effective for changing health behaviours?

1.3 Report structure

The report begins with an outline of the research approach (Chapter 2). This is followed by an overview of online and mobile technologies and their use by New Zealanders' (Chapter 3). Chapter 4 outlines the key benefits and opportunities of using online and mobile technologies for health behaviour change and profiles three New Zealand programmes that use these technologies. Chapter 5 presents findings from systematic reviews, meta-analyses and other reviews relating to the effectiveness of online and mobile technologies for achieving health behaviour change. Chapter 6 summarises key lessons for the use of online and mobile technologies in health promotion, including research and evaluation considerations.

2. Approach

A mixed-method approach involving literature review and key informant interviews was used for this review. This chapter provides details of the two methods.

2.1 Literature review

Scope

The scope of the literature review was informed by the overarching review question: *What evidence is there that online and mobile technologies are effective for changing health behaviour*s*?* The scope included:

- Literature on the use of online and mobile technologies to promote health behaviours, with a focus on weight management, nutrition, physical activity and smoking cessation
  - Weight management, nutrition and physical activity were included because they are the focus of Agencies for Nutrition Action work (www.ana.org.nz)
  - Smoking cessation was included because online and mobile technologies have been used to promote smoking cessation for a number of years, potentially offering lessons for other health promotion areas
- Literature published from 2009 onwards
- Published and unpublished literature
- Literature reviews, systematic reviews and meta-analyses
- English language literature.

Search mechanisms

A search of the published literature was undertaken through MEDLINE in March 2013. This database gave access to a wide range of national and international peer reviewed medical and public health journals.

Internet searches were undertaken during the same period to obtain additional published and unpublished articles and research reports. These searches were undertaken using the Google search engine (www.google.com) and through searching websites of various government and non-government agencies with a public health focus.

A bibliographic search of key articles obtained via the above searches led to the identification and inclusion of further articles.

The databases and other sources listed above yielded a number of articles, with each resultant article screened for relevance to the overarching review question.

Search limits and terms

Keyword entries were made across several database search fields. The following search limits were used for time of publication and language:

- Published in 2009 or later

- English language.

Keyword entries consisted of a range of search terms entered in a variety of combinations, utilising the appropriate truncation facility of the search engine being used. See Appendix A for core search terms.

It was intended that database searches would be conducted in two waves: an initial search focusing on systematic reviews and meta-analyses and a subsequent search focusing on primary research studies. However, the initial search yielded around 30 relevant reviews covering a wide range of health areas; this was deemed sufficient for the purpose and scope of the review.

Review and analysis

Once all articles and reports considered applicable to the review were located, findings were critically examined to determine conformity with review scope and relevance to review topic. Specifically, items were assessed for relevance to the following review questions:

- Opportunities online and mobile technologies provide for health promotion interventions
- Effectiveness of online and mobile technologies for changing health behaviours
- Long-term effectiveness
- Cost-effectiveness
- Effectiveness of different intervention features.

Note that findings were not weighted according to study methodology.

2.2   Key informant interviews

Five interviews were conducted with government, non-government and academic organisations involved in researching and delivering health promotion programmes that use online and mobile technologies. All had a focus on nutrition, physical activity or smoking cessation. An interview was also undertaken with Sport NZ. This interview confirmed that, while Sport NZ has an interest in the health benefits of sport and recreation, its programmes' are focused on sporting rather than health outcomes. See Appendix B for a list of participating organisations.

The purpose of the interviews was to understand how online and mobile technologies are being used to promote health behaviours in selected New Zealand programmes, why they are being used and what research and evaluation is being undertaken to inform or evaluate effectiveness. Information from interviews is woven throughout the report and presented as case studies.

3. Use of online and mobile technologies

Surveys show that increasing numbers of New Zealanders use the Internet to engage in an ever more diverse array of online activities. Our growing online engagement is enabled by the widespread availability of the Internet and the advent of Internet-enabled mobile technologies, enabling us to go online anywhere, anytime.

This chapter provides a brief overview of online and mobile technologies accessed via the Internet and mobile devices, and New Zealanders' use of these technologies.

3.1 Interactive technologies

As identified in the Introduction, in this report 'online and mobile technologies' refers to Internet, mobile devices and interactive technologies accessed via the Internet and mobile devices. Interactive technologies are technologies that enable users to interact with and influence content. The shift from Web 1.0 to Web 2.0 platforms reflects the growing importance of interactive technologies.

Interactive technologies accessed via the Internet include:

- Websites
- Email
- Online chat
- Online phone and videoconferencing
- Online gaming
- Blogs
- Social networking sites.

Interactive technologies accessed via mobile devices include:

- Voice calls
- Texting (short message service or SMS)
- Sending photos and videos (multiple media service or MMS)
- Sending data
- Multi-media playback
- Internet
- Email
- Applications ('apps')
- Gaming
- Short-range wireless communication (eg, Bluetooth).

Mobile devices refer to:

1. Traditional mobile phones, capable of communicating via voice and text message
2. Mobile computing devices such as:

- Personal Digital Assistants (PDAs, eg, Palm Pilots)[1]
- Portable Media Players (eg, iPODs)
- Handheld videogame consoles (eg, Playstation Portable or PSP, Nintendo DS)
- Handheld and ultra-portable computers (eg, iPads, tablet PCs and Smartbooks)
- Smartphones.

Mobile computing devices use an operating system and can run various types of application software. Most can be equipped with Wi-Fi, Bluetooth and GPS capabilities that allow connections to the Internet and other Bluetooth capable devices.

Figure 1 depicts interactive technologies accessed via the Internet and mobile devices. More information on these technologies can be found in the Glossary (Appendix C).

Figure 1: Interactive technologies available through the Internet and mobile devices
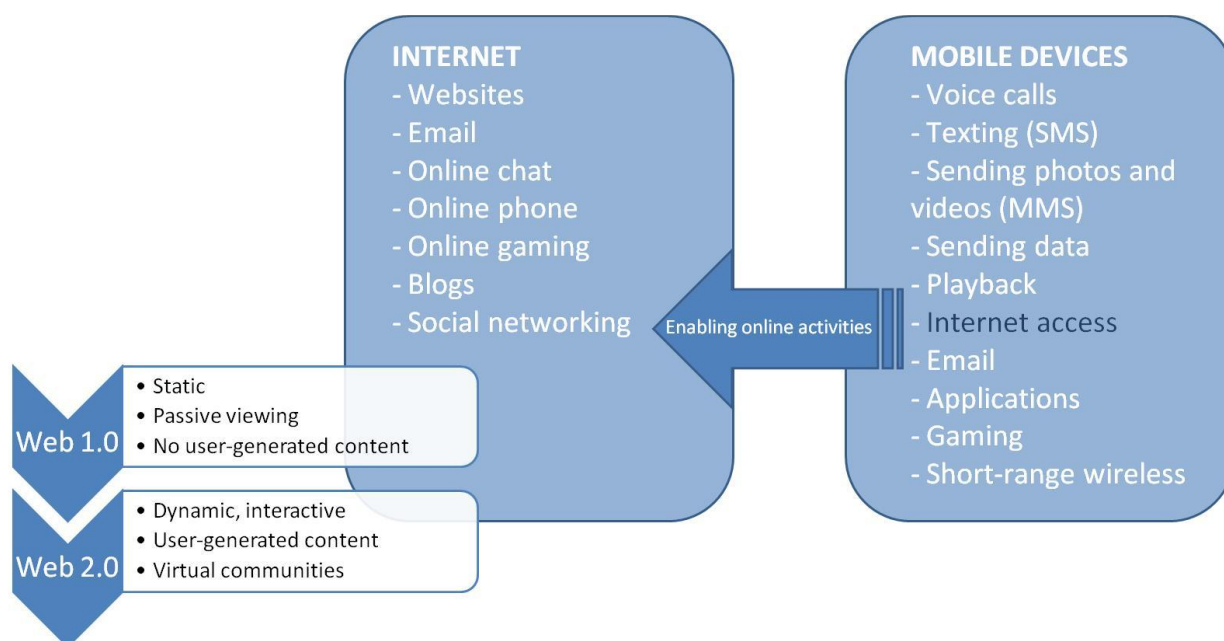
3.2 Use in New Zealand

Use of online and mobile technologies has grown exponentially in recent years, both globally and in New Zealand.

Globally

The International Telecommunication Union (2013) estimates that in 2013:

- 40% of the world's population use the Internet. This has increased from 16% in 2005. In the developed world an estimated 77% of the population use the Internet.

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[1] A PDA is a handheld electronic device used to access the Internet, send email and organise information. Unlike smartphones, traditional PDAs do not have phone services.

- There are 6.8 billion mobile phone subscriptions worldwide, representing a global penetration rate of 96%. This has increased from 34% in 2005. In the developed world the mobile phone penetration rate is estimated at 128%.
- There are 2.1 billion mobile Internet subscriptions worldwide, representing 30% penetration. In the developed world the mobile Internet penetration rate is estimated at 75%.

New Zealand

Findings from the World Internet Project[2] (Smith et al., 2011) indicate that in 2011:

- 86% of adult New Zealanders used the Internet; this was an increase from 47% in 2000. Most adults who do not use the Internet are aged over 60 years or in a low-income household, or both.
- 91% of Internet-users who had an Internet connection at home, had broadband.
- 54% of Internet-users went online mostly from a communal space in their home; this is a sign of growing Internet mobility through wireless access.
- 27% of Internet-users accessed the Internet from a mobile device such as a smartphone or tablet; this was an increase from 7% in 2007.
- 98% of Internet-users checked their email and 77% checked it daily; older people's email use is increasing and younger people's use is decreasing.
- 42% of Internet-users made or received calls online (through Skype, for example); this was nearly double the proportion in 2007.
- 64% of Internet-users belonged to a social network site and of these, 96% used Facebook; 87% of under-30s used social networking sites but only 34% of over 60-year-olds.
- 39% of New Zealanders texted family or friends every day.

Data from other sources show that:

- In 2011 there were 4.8 million mobile phone subscriptions in New Zealand, representing a population penetration rate of 109%; in 2000, this rate was 40% (ITU, 2011).
- 66% of New Zealanders have a laptop or notebook, 61% have a desktop computer, 48% have a smartphone and 29% have a tablet or iPad (Research NZ, 2013).
- The most commonly used smartphone and tablet apps are:
  - Social networking sites such as Facebook (76%)
  - News and weather apps (70%)
  - Apps for games and other entertainment (eg, movies) (70%)
  - Business / banking apps (54%)
  - Apps for government agencies (16%) (Research NZ, 2013).

These statistics confirm the growing ubiquity of the Internet in New Zealand life, the increasing accessibility of the Internet due to Wi-Fi and Internet-enabled mobile devices, and the growing importance of social media.

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[2] The third World Internet Project survey was conducted in July-August 2011. Telephone interviews were conducted with a nationally representative sample of 1,255 New Zealanders aged 12 years and over (Smith et al., 2011).

4. Use of online and mobile technologies in health

Advances in the capabilities and use of online and mobile technologies have prompted growing interest in the use of these technologies for health care and public health. Online and mobile technologies are increasingly being used to:

- Promote healthy lifestyles
- Encourage and support people to self-manage chronic conditions
- Encourage and support medication adherence
- Facilitate communication between health care providers and patients
- Provide clinical management support.

This review focuses on the use of online and mobile technologies for *promoting healthy lifestyles*; in particular, the effectiveness of Internet and mobile-based interventions[3] for changing health behaviours. This chapter outlines the key benefits and opportunities of using online and mobile technologies in health behaviour change interventions and profiles three New Zealand interventions that use these technologies.

4.1 Opportunities for changing health behaviour

Online and mobile technologies offer a range of benefits and opportunities for changing health behaviour. These relate to reach, accessibility, interactivity, cost-effectiveness and data collection. Each of these is discussed below.

Reach

High levels of Internet and mobile device use mean that health promotion interventions that utilise these technologies can reach large numbers of people, at a relatively low cost (Cugelman et al., 2011; Davies et al., 2012; Freeman et al., 2013; Kodama et al., 2012; Lau et al., 2011; Neville et al., 2009a). Internet and mobile-based interventions can also reach audiences that might not otherwise engage with traditional health promotion interventions. For example, young people may be more likely to access smoking cessation services delivered via the Internet or mobile than those delivered via traditional channels such as health professionals or phone counselling (Civljak et al., 2010).

Accessibility

The ability to engage anywhere, anytime, is a key benefit of Internet and mobile-based health promotion interventions. The widespread availability of the Internet, at home, work, in the community and increasingly on mobile devices, means that people can access online interventions 24 hours a day and 365 days a year, regardless of where they live and what physical services are available (Civljak et al., 2010; Davies et al., 2012; Kodama et al.,

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[3] In this report, 'Internet and mobile-based interventions' include interventions that use *only* online or mobile technologies and interventions that use online and mobile technologies *alongside* other delivery channels (such as face to face counselling).

2012). Online and mobile interventions can overcome the time and travel barriers of traditional interpersonal interventions and are not limited by service availability (eg, opening hours, appointments) (Wieland et al., 2012).

The particular advantage of mobile-based interventions is that people tend to carry their mobile device with them, wherever they go. This means that (Fanning et al., 2012; Free et al., 2013; Whittaker et al., 2012):

- People can engage with health promotion material anywhere, anytime
- Material can be easily delivered, on a device that people already carry with them
- The intervention can claim people's attention when it is most relevant (eg, users can be sent text messages to sustain their motivation to quit smoking throughout the day)
- Interventions can be accessed or delivered within the relevant context (eg, smokers can request support when experiencing a craving).

Interactivity

Internet and mobile-based health promotion interventions can offer interactive features that are similar to those found in interpersonal counselling (Reed et al., 2011). These features include:

- Motivational messaging
- Modelling of desired attitudes or behaviours
- Tailoring of content to suit the individual user
- Support.

Tailoring is a key benefit of Internet and mobile-based health promotion interventions. Like one-on-one counselling, it involves collecting information about the intervention-user, such as age, sex, and ethnic group, as well as information about the particular behavioural issues the user faces, and using this information to generate personalised feedback and advice (Free et al., 2013). Research shows that intervention materials tailored to individual users are more effective than untailored materials (Cviljak et al., 2010).

With the automation capabilities of online and mobile technologies, mass interpersonal, tailored interventions are possible. Large populations can be engaged in automated relationships that resemble the personalised support offered by dietitians, fitness trainers and smoking cessation counsellors, but at a relatively lower cost than interpersonal therapy (Hutton et al., 2011). Personalised feedback tends to be delivered via email or text. As noted above, mobile-based interventions allow personalised feedback and support to be provided 24/7 and at times most relevant to the user (Fanning et al., 2012).

Support is a key element of any interpersonal intervention. In addition to personalised support communicated via email and text, online and mobile technologies allow intervention users to link with other users for social support (Lau et al., 2011; Whittaker et al., 2012). Note however that, for some people, the ability to engage anonymously is a key benefit of Internet and mobile-based interventions.

Cost-effectiveness

Cost-effectiveness is often cited as a benefit of Internet and mobile-based health promotion interventions (Cugelman et al., 2011). In relation to weight management, the World Health Organization notes that Internet-based interventions may serve as an efficient and cost-effective method of meeting the growing public health need associated with rising obesity levels (World Health Organization, 2011). Online and mobile technologies offer:

- Low cost per user: Internet and mobile-based interventions have the potential to be delivered at a relatively lower cost per user than face to face interventions (Cviljak et al., 2010; Harris et al., 2011). Interventions might be costly to set up but their delivery tends to be very cheap as they require little in the way of labour costs to deliver (Chen et al., 2012).
- Scalability: Internet and mobile-based interventions offer potential economies of scale; it is technically easy to deliver interventions to large populations and costs little more than delivering to small numbers (Chen et al., 2012; Free et al., 2013; Shahab and McEwen, 2009; Whittaker et al., 2012).
- Large impact: The reach of online and mobile technologies gives interventions that use these technologies the ability to have a major public health impact (Glasgow, 2007, cited in Wieland et al., 2012). Even small changes in a health behaviour have the potential for large, positive changes at the population level (Davies et al., 2012).

Data collection

Internet and mobile technologies enable data collection with little additional burden. For example, Internet-based interventions can readily test the efficacy of different intervention components and delivery modes, and their efficacy in different populations (Hutton et al., 2011). Mobile phone-based physical activity interventions can collect objective, self-report measures of activity in real time; this ability is enhanced further with smartphones that have built-in sensors (eg., accelerometers and GPS devices), providing the opportunity for more accurate assessment of physical activity behaviour in real time, as well as geographic location information (Fanning et al., 2012).

4.2   New Zealand programmes

In New Zealand, online and mobile technologies are being used to promote nutrition, breastfeeding, and smoking cessation, among other health behaviours. *Breakfast Eaters Have It Better*, the *National Breastfeeding* campaign and *Quitline* are profiled below.

Consistent with the benefits listed in Section 4.1, ability to access target populations in a cost-effective way is a key driver of use of online and mobile technologies in New Zealand programmes. In *Breakfast Eaters* and *Breastfeeding*, the interactive capabilities of online technologies are valued for the opportunities they provide for conversations and support. At the *Quitline*, interactive capabilities are valued for the opportunity to provide personalised feedback and advice (elements central to all Quitline service channels).

Breakfast Eaters Have It Better (Health Promotion Agency)

Breakfast Eaters is part of the Health Promotion Agency's (HPA) Nutrition and Physical Activity Programme.

Aim: To increase the number of children and families eating breakfast every day.

Priority audiences: Parents and caregivers of children aged 5 to 14 years old, with a particular focus on low-income, Māori and Pacific families.

Digital tools: Website (www.breakfast-eaters.org.nz); Facebook site; electronic newsletters (e-news).

Other tools: Paid and unpaid media, community projects and activities, stakeholder engagement, print resources and research dissemination.

Reasons for developing an online presence:

- Reach: HPA responded to growing evidence that the *Breakfast Eaters* audience is online (*"this is where our audience is"*).
- Interactivity: Online tools enable two-way engagement between the programme and its audience. HPA believe that enabling audience members to participate in the conversation, and choose when and how they engage with the programme will enhance the likelihood of behaviour change.
- Cost-effectiveness: Online tools are seen to offer high reach at a relatively low cost. HPA notes however that maintaining an effective online presence requires significant internal resource investment (for initial design, promotion and ongoing management).

Factors seen to enhance effectiveness of online tools:

- Investing in maintaining a high profile, by promoting the website and Facebook site and ensuring regular and dynamic posts
- Constantly reviewing what works and what doesn't; it's important to understand your audience
- Use of photos and images
- Posting 'controversial' questions that people want to respond to (eg, "Vegemite or Marmite?")
- Using online tools as part of a wider, integrated campaign approach.

Campaign evaluation comprises two key elements:

1. Assessing online reach using online metrics:
   - Facebook weekly total reach + Unique website visitors + Unique opens of e-newsletters provides a measure of online reach
2. Collecting survey data on desired behaviours from the target population
   - Proportion of Māori and Pacific parents and caregivers of 5-14 year old children who report that their child eats breakfast every day
   - Proportion of Māori and Pacific parents and caregivers of 5-14 year old children who agree or strongly agree that "What my child eats affects his/her performance at school".

National Breastfeeding Campaign (Ministry of Health and GSL Network)

Aim: To increase breastfeeding rates.

Priority audiences: New and prospective mothers, especially Māori and Pacific mothers.

Digital tools: Blog (http://breastfeedingnz.wordpress.com/); Facebook site (https://www.facebook.com/breastfeedingnz). This profile focuses on the Facebook site, which is delivered by GSL Network.

Other tools: DVD, e-newsletter, promotion at events, wristbands and coffee group packs. Prior to the launch of the Facebook site, there was a mass media campaign that included television, radio and billboard advertisements.

Reasons for developing an online presence:

- Accessibility: The Ministry of Health and GSL identified that new mothers are looking for support 24/7.
- Cost-effectiveness.

Factors believed to enhance effectiveness of online tools:

- Having a clear campaign strategy
- Promoting the site with online advertising
- Basing the online strategy on a wider campaign approach that includes other media
- Having an online campaign manager who understands social media and how to maximise its effectiveness, and stays up to date with technological developments
- Using community managers who seed and re-post posts (based on a three-month strategy for use of the Facebook site), monitor discussions, and respond to questions
- Recent introduction of live chat with a technical expert expected to be successful.

Campaign evaluation comprises two elements:

1. Assessing Facebook engagement using online metrics
   - eg, number of 'likes', number of 'People Talking About This', number of 'Friends of Fans'
   - member demographics.
2. Monitoring national breastfeeding data (collected by Plunket).

Quitline (The Quit Group)

The Quit Group provides an integrated smoking cessation service that includes a phone service, a website, emails, blogs, text messages and Quit coaches (www.quit.org.nz).

Aim: To increase smoking cessation.

Priority audiences: Māori, Pacific peoples and pregnant woman who smoke.

Digital tools: Website, text messages (Txt2Quit), blogs (Quit Group clients only), and emails. The Quit Group also has a Facebook presence however this is not an integrated service delivery mechanism like the website and Txt2Quit.

Other tools: Quitline phone service, smoking cessation counsellors (Quit Coaches).

Reasons for building online and mobile technologies into the Quitline service:

- Accessibility: Clients can access the Internet and be accessed via their mobile phone 24/7.
- Enhanced effectiveness through use of multiple channels.

Factors seen to enhance effectiveness of online and mobile tools:

- Basing the service on a sound theoretical model
- Providing people with service choices.

Service evaluation comprises two key components:

1. Monitoring service use statistics
   - eg, proportion of clients using multiple services; proportion of Quitline versus client-initiated contacts
2. Regular service evaluation that includes a longitudinal survey of Quit Group clients' that measures quit rates at four weeks, six months and 12 months after their quit date.

Results from the latest evaluation (The Quit Group, 2012) show that:

- The most widely used service was the Quitline phone service (72.4% of respondents), followed by the Quitline website (41.0%), emails (30.1%), Quit blogs (14.8%), Txt2Quit (13.1%) and Quit Coach (8.9%).
- Māori, Pacific and older clients were more likely to use the Quitline phone service, non-Māori and non-Pacific clients were more likely to use the website and emails and clients younger than 25 years were more likely to use Txt2Quit.
- Use of more service channels was associated with a higher quit rate - people who used a combination of the phone service, online services and Txt2Quit had the highest quit rate.

5. Effectiveness of online and mobile technologies

This chapter presents findings from recent reviews relating to the effectiveness of Internet and mobile-based health promotion interventions. The first section provides a summary of articles included in the review. Subsequent sections address the key review questions of overall effectiveness, long-term effectiveness, cost-effectiveness and effectiveness of intervention features.

5.1 Description of articles

Twenty-two articles were included in this review. Characteristics of the articles are summarised below and in Table 1.

- **Health behaviour addressed**: Four articles reviewed interventions to change physical activity (PA) behaviours, seven reviewed interventions to achieve weight loss or maintenance, two focused on interventions to change dietary behaviours, five focused on interventions to reduce smoking, and four focused on interventions relating to a mix of health behaviours.
- **Technology used**: Most articles reviewed Internet-based interventions (12). Eight articles reviewed interventions that used any form of online or mobile technology. Only two articles focused solely on mobile technologies. Despite the range of interactive technologies available through the Internet and mobile devices (see Figure 1), interventions tended to use the more traditional technologies, such as websites, email and texting. Few reviews identified interventions that used more recent interactive technologies, such as social networking sites and smartphone apps. This is a reflection of the recency and fast-changing nature of these technologies, and the time lag between the emergence of new technologies, their use in health promotion, evaluation and publication.
- **Study type**: Three of the articles were systematic reviews, seven were meta-analyses, three were narrative systematic reviews (ie, descriptive synthesis of study findings), seven were systematic reviews combined with meta-analysis and one was a systematic review combined with a cost-effectiveness analysis. An economic evaluation was also included to inform cost-effectiveness findings.
- **Intervention audiences**: Most articles focused on behaviour change in adults; only three articles explicitly reviewed interventions focused on adolescents.

Table 1: Characteristics of articles included in the review

Health behaviour addressed	TOTAL	Technology used			Study type					
		Internet	Mobile	Internet and/or mobile	SR	Meta-analysis	Narrative SR	SR and meta-analysis	SR and CE analysis	Economic evaluation
Physical activity	4	1	1	2	1	2	1	-	-	-
Weight management	7	5	-	2	1	1	1	3	-	-
Diet	2	-	-	2	1		1		1	1
Smoking cessation	5	3	1	1	-	2	-	3	-	-
Multiple	4	3	-	1	-	2	-	1	-	--
TOTAL	**22**	**12**	**2**	**8**	**3**	**7**	**3**	**7**	**1**	**1**

*SR is systematic review; CE is cost effectiveness

5.2 Overall effectiveness

Internet-based interventions

Internet-based interventions can have small but significant positive effects on behaviours such as physical activity, diet, weight management and smoking cessation (Cugelman et al., 2011; Webb et al., 2010). These effects tend to be short-term. One review concludes that "*online interventions offer a small effect and are probably as good as print interventions, but with the advantage of lower costs and larger reach*" (p12, Cugelman et al., 2011).

With regard to **physical activity**:

- Internet-based interventions have a smaller effect size than in-person interventions (Davies et al., 2012).
- Tailored interventions[4] can have positive, short to medium-term effects (Neville et al., 2009a).

With regard to **weight management,** Internet-based interventions can be:

- As effective or more effective than no intervention or minimal intervention, but generally less effective than in-person interventions (Kodama et al., 2012; Neve et al., 2010; Wieland et al., 2012)
- Effective as a supplement to standard weight loss intervention but not as a substitute (Kodama et al., 2012; Reed et al., 2012)
- More effective with enhanced features such as tailored feedback and self-monitoring (Manzoni et al., 2011; Neve et al., 2010).

With regard to **smoking cessation**, Internet-based interventions can be:

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[4] Internet <u>and</u> desktop technologies were included in this review (Neville et al., 2009a).

- Effective but results are inconsistent (Civljak et al., 2010; Hutton et al., 2011; Shahab and McEwen, 2009)
- Modestly effective for adults but evidence for adolescents is insufficient (Hutton et al, 2011)
- More effective with enhanced features such as tailored feedback and frequent, automated contacts (Civljak et al., 2010; Shahab and McEwen, 2009)
- Slightly less effective than interventions targeting other health behaviours (Webb et al., 2010).

Internet-based interventions that target multiple health behaviours tend to have slightly smaller effect sizes than those targeting single behaviours (Webb et al., 2010).

Mobile-based interventions

Evidence for the effectiveness of mobile-based interventions is mixed (Free et al., 2013). The strongest evidence is for the use of text messaging interventions to achieve smoking cessation.

With regard to **physical activity**:

- There is suggestive evidence of short-term benefits of mobile-based interventions for physical activity Fanning et al., 2012; Free et al., 2013).

With regard to **weight management**:

- Mobile-based interventions targeting diet or diet and physical activity have no or small benefits for weight management (Free et al., 2013)

With regard to **smoking cessation:**

- There is strong evidence that automated, multifaceted text messaging interventions can increase smoking cessation (Free et al., 2013), including over the longer-term (Whittaker et al., 2012).

Internet and/or mobile-based interventions

Consistent with the evidence for Internet-only interventions, reviews of interventions that use *any form* of Internet, computer or mobile technologies, have identified small, short-term positive effects on health behaviours.[5]

With regard to **physical activity**:

- Internet and mobile-based interventions can have positive effects on physical activity behaviour change among children and adolescents, especially when used alongside other delivery approaches such as in-person counselling (Lau et al., 2011)
- There is consistent evidence for positive effects of Internet and mobile-based interventions on psychosocial variables relating to physical activity (eg, intention, self-

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[5] This consistency in findings may reflect the dominance of Internet technologies in the interventions reviewed; fewer interventions used mobile technologies.

efficacy, stage of change) but less consistent evidence for positive effects on behavioural variables (energy expenditure, step-count, self-reported physical activity; Lau et al., 2011).

With regard to **weight management**:

- Tailored Internet and mobile-based interventions can have positive effects for weight management but the evidence is limited to a small number of heterogeneous studies, making it difficult to determine whether positive effects are generalisable and sustained (Neville et al., 2009c).

With regard to **diet**:

- Tailored Internet and mobile-based interventions can have significant, positive short to medium-term effects for dietary behaviour but, as for weight management, there is uncertainty regarding whether positive effects are generalisable and can be sustained long-term (Neville et al., 2009b).
- One review found that tailored interventions are ineffective in producing clinically significant changes in dietary behaviour (Harris et al., 2011).

With regard to **smoking cessation**:

- Internet and mobile-based interventions can be more effective than no intervention or general self-help materials, however, the effect size is small (Chen et al., 2012; Hutton et al., 2011).

> The above summary of evidence shows that, while Internet and mobile-based interventions can have positive effects on a range of health behaviours, these effects tend to be small and short-term, raising questions about the long-term sustainability and clinical significance of any benefits achieved.

5.3 Long-term effectiveness

There is limited evidence that Internet and mobile-based interventions can change health behaviours in the long term; most evidence for effectiveness relates to the short-term. The main exception appears to be smoking cessation where there is evidence that mobile phone texting interventions can increase long term quit rates (Whittaker et al., 2012) and some evidence that the impact of Internet-based interventions can be long lasting (Cviljak et al., 2010; Shahab and McEwen, 2009).

The limited evidence for the long-term effectiveness of Internet and mobile-based interventions reflects two factors:

1. A lack of research conducted over longer periods: Several reviews found that studies did not include information on the long-term impact of interventions and recommended that this be a priority for future research.
2. Evidence that the effectiveness of Internet and mobile-based interventions diminishes over time: One review concluded that shorter interventions achieve the largest impacts and that, for some behaviours (eg, dietary choices), highly tailored single-session interventions produce the strongest effect sizes (Cugelman et al.,

2011). In relation to weight management, reviews found that the effect of Internet-based interventions was not sustained in the longer-term (Kodama et al., 2012; Reed et al., 2012; Wieland et al., 2012).

5.4 Cost-effectiveness

Despite cost-effectiveness being one of the most commonly cited reasons for using Internet and mobile-based interventions, surprisingly few intervention studies have evaluated cost-effectiveness. Two studies that assessed the cost-effectiveness of Internet and mobile-based interventions reached different conclusions:

- The first study found that using e-learning devices (interactive technologies delivered via computers and mobile devices) for managing the weight of obese individuals is unlikely to be cost-effective unless the fixed costs of e-learning devices reduces or future technologies prove to be much more effective at reducing weight (Miners et al., 2012).
- The second study found that use of Internet, computer programmes, mobile phones and other electronic aids can be cost-effective when added to non-electronic behavioural support such as brief advice or intensive counselling (Chen et al., 2012).

A third study that provided an overall review of the cost-effectiveness of Internet-based interventions found that (Tate et al., 2009):

- A limited number of studies incorporate economic endpoints into analyses and most have significant methodological shortcomings
- There is a lack of detail on cost and cost-effectiveness of Internet interventions relative to traditional delivery methods, making it difficult to determine whether or not these interventions are a good use of health care resources.

The authors of the third study emphasise that, as the field of online and mobile health promotion moves towards evaluation of effectiveness, it is important that cost-effectiveness data be collected to guide further development and research as well as potential health care and dissemination decisions (Tate et al., 2009). This sentiment is echoed in several reviews included in this report (Davies et al., 2012; Neville et al., 2009a, 2009b, 2009c). Davies et al. (2012) suggest that future studies need to evaluate cost-effectiveness in terms of development, maintenance and breadth of delivery of Internet-delivered interventions, to allow comparisons to traditional modes of delivery.

5.5 Effectiveness of intervention features

Previous research on Internet-based interventions has found that features such as tailored content (using user information to provide personalised feedback and support), multiple exposures (how much interaction a user has with an intervention), updated content, goal setting and self-monitoring can enhance effectiveness. This review also found evidence for the effectiveness of many of these features (see below).

There was limited information, however, on which features of mobile-based interventions are associated with enhanced effectiveness. This probably reflects the smaller body of research on mobile technologies compared with Internet technologies and the tendency for mobile

technologies to be used alongside (but not isolated from) Internet technologies. Fanning et al. (2012) found that, in relation to physical activity interventions, mobile devices are mainly used as data collection methods (eg, steps reported via text message) or as supplemental materials (eg, provision of feedback via text message) to a broader behaviour change intervention relying on more traditional methods (eg, face to face counselling); they could not determine the contribution of mobile device components to changing physical activity behaviours.

With regard to Internet-based interventions, the reviews included in this report found that the features discussed below are associated with increased effectiveness.

Use of automated, tailored feedback

There is reasonably consistent evidence that automated, tailored feedback and support can increase the effectiveness of Internet-based interventions (Civljak et al., 2010; Hutton et al., 2011; Manzoni et al., 2011; Neville et al., 2009b; Shahab and McEwen, 2009; Webb et al., 2010). There is also evidence that other automated functions, such as supplementary content and links, testimonials, videos or games, can increase the effectiveness of Internet-based interventions (Webb et al., 2010)

Use of supplementary communication and in-person support

There is reasonably consistent evidence that Internet-based interventions can be more effective if supplemented by face to face approaches (Lau et al., 2011; Webb et al., 2010). [Note that for weight management, use of the Internet as an adjunct to face to face obesity care is effective but using it instead of face to face care is not effective (Kodama et al., 2012).]

There is also evidence that Internet-based interventions can be more effective if supplemented by additional communication methods such as texting (Webb et al., 2010). Davies et al. (2012) found that including structured educational materials that involve the exchange of information increases the effectiveness of Internet-based physical activity interventions.

Use of theory

Theory can inform interventions in a number of different ways, from identifying theoretical constructs to be targeted (eg, attitudes, self-efficacy) or mechanisms underlying particular behaviour change techniques (eg, observational learning), to selecting participants most likely to benefit (eg, people with particularly negative attitudes). Webb et al. (2010) found that:

- Increased use of theory in Internet-based interventions has a significant positive impact on effect sizes
- Internet-based interventions that use theory or predictors to select participants for the intervention tend to have the largest effects on behaviour
- Social Cognitive Theory, Transtheoretical Model and Theory of Planned Behaviour (TPB) are the most commonly used theories; interventions based on TPB have the largest effect on behaviour.

Lau et al. (2011) and Neville et al. (2009b) also found that interventions grounded in behaviour change theory are associated with greater effect sizes.

In relation to interventions that use mobile technologies, Fanning et al. (2012) questions whether current behavioural theories are adequate. The authors suggest that current theories may account for baseline state but not the interplay between user experiences and the dynamic and adaptable nature of mobile interventions. Mobile technology interventions may need to account for inter- and intra-individual change theories.

Use of multiple behavioural change and influence techniques

Behaviour change techniques refer to the specific strategies used in an intervention to promote behaviour change. Webb et al. (2010) found that:

- Providing information on consequences of behaviour, prompting self-monitoring of behaviour, identifying barriers and/or problem solving are the most commonly used behaviour change techniques for Internet-based interventions.
- The number of behaviour change techniques used in an Internet-based intervention has a significant positive impact on effect size; interventions that use more techniques tend to have larger effects on behaviour than interventions that use fewer techniques.

Cugelman et al. (2011) also found a relationship between the number of techniques designed to influence behaviour and the effectiveness of Internet-based interventions.

Investigator-initiated contact

There is some evidence that Internet and mobile-based interventions that use investigator-initiation strategies (ie, investigator delivers information to participants at a fixed time, venue and under specific conditions) are more likely to be effective (Lau et al., 2011). Lau et al. suggest that this might be because investigator-initiation is a 'push' approach (automatic and specific materials are directly emailed or texted to a participant); the participant does not have to plan how to engage with the intervention. Note that, unlike the other findings regarding intervention effectiveness, this finding may also apply to mobile technologies as Lau et al. included mobile phones in their review.

Greater intervention exposure (dose)

There is evidence in smoking cessation that increased intervention exposure is associated with increased effectiveness of Internet-based interventions (Hutton et al., 2011). However, Neville et al. (2009b) found little evidence that success is more likely in interventions of greater intensity when targeting dietary change.

Shorter time-frames

As noted previously, there is evidence that shorter interventions achieve larger impacts than longer-term interventions. Cugelman et al. (2011) suggest that, as the duration of an intervention increases behavioural outcomes decrease, potentially reflecting diminishing motivation to continue to adhere to the intervention design and study design.

5.6 Research limitations

Research undertaken to gauge the effectiveness of Internet and mobile-based health promotion interventions has a number of limitations. These limitations limit our ability to determine the overall effectiveness of online and mobile interventions, which types of technology are most effective, why they are most effective (change mechanisms) and in what situations they are most effective (delivery approaches). Key limitations include:

- Heterogeneity in intervention design, evaluation approaches and effect sizes: this makes it difficult to compare results across studies and estimate overall effectiveness of different types of interventions (Davies et al., 2012; Harris et al., 2011; Hutton et al., 2011; Kodama et al., 2011; Manzoni et al., 2011).
- Lack of information on intervention design: this makes it difficult to determine how an intervention achieves change and which features are most effective (Davies et al., 2012; Manzoni et al., 2011).
- Variable information on intervention exposure and adherence: this makes it difficult to be confident that any effects achieved can be attributed to users engaging with the intervention as intended (Kodama et al., 2012); there are no standard measures of exposure and adherence (Brouwer et al., 2011; Manzoni et al., 2011).
- Lack of comparison with other delivery approaches: this makes it difficult to compare the effectiveness of online and mobile interventions with traditional delivery approaches (Lau et al., 2011).
- Lack of information on users: this makes it difficult to know whether different types of interventions are more or less effective for different user groups (eg, women compared with men, lower socioeconomic status compared with high socioeconomic status).
- Lack of generalisability: most intervention studies are conducted in developed countries, limiting confidence that interventions will be similarly effective in other settings (Free et al., 2013; Hutton et al., 2011).
- Lack of theoretical foundations: this makes it difficult to understand the underlying mechanisms for change (Hutton et al., 2011; Lau et al., 2011).
- Lack of evaluation of the long-term impact of interventions: this makes it difficult to know whether positive effects achieved can be sustained over a longer timeframe (see Section 5.3).
- Lack of cost-effectiveness evaluation: this makes conclusions about cost-effectiveness difficult (Wieland et al., 2012; see Section 5.4).
- Small number of studies: this limits confidence in estimates of overall effectiveness of different types of interventions (Davies et al., 2012; Fanning et al., 2012)
- Lack of research on mobile technologies other than texting: Texting is the main mobile technology used in interventions (Fanning et al., 2012); few reviews identified studies on the use of smartphones and apps in health promotion.
- Lack of research on use of social media, such as social networking and blogging.
- Of specific concern to New Zealanders, there is limited research on the effectiveness of online and mobile technologies for Māori and Pacific populations.

5.7   Other review findings

In addition to the systematic reviews and meta-analyses reviewed in previous sections, other reviews have identified the lack of information on the effectiveness of online and mobile technologies for health behaviour change.

A review of tobacco control digital media campaigns found that there is little information on how digital media (technologies accessed through the Internet or mobile technology) is being used, or its effectiveness in reducing smoking or second-hand smoke exposure (Gutierrez and Newcombe, 2012). The authors concluded that:

- Digital media campaigns should not be conducted in isolation or to the exclusion of other key tobacco control interventions; they should be part of multi-faceted, comprehensive tobacco control programmes
- Digital media interventions are likely to have the greatest impact when combined with traditional mass media interventions as well as other tobacco control policy and programme interventions
- Many campaigns lack research and evaluation; thorough research and evaluation is necessary in order to draw conclusions about campaigns and their effectiveness, understand what went well, and determine what needs to be improved going forward.

Similarly, a literature review on the effectiveness of social media identified a paucity of peer-reviewed studies testing the effectiveness of social media interventions for changing health behaviours (Schein, Wilson and Keelan, 2010). The authors found that:

- Social media is used by public health organisations as a broadcasting platform, to amplify messages from traditional channels, and as an entirely new way of collaborating and co-creating content with target audiences
- More research is needed to understand and determine the impact of social media on issue-awareness, behaviour change and health outcomes.

5.8   Evaluating effectiveness in New Zealand programmes

Interviews with *Breakfast Eaters*, *Breastfeeding* and *Quitline* programme personnel reveal good alignment between features identified in the literature as being associated with effectiveness and factors identified by programme personnel as important for success (see case studies on pages 12-14). Factors perceived by programme personnel to enhance the effectiveness of online and mobile tools include:

- Promoting online features
- Situating online and mobile tools within a wider, integrated intervention approach
- Using online and mobile tools alongside other delivery channels
- Offering people choices regarding how they engage with a programme
- Basing interventions, including online and mobile channels, on a strong theoretical foundation.

With regard to evaluation, *Breakfast Eaters* and *Breastfeeding* both make use of metrics for monitoring reach and engagement with online tools. Both programmes collect or access information on the overall behaviour of interest (breakfast eating and breastfeeding); neither

programme is able to draw a link between engagement with online features and behaviour change in target populations.

The *Quitline*, in comparison, is able to use its comprehensive client information system to collect information on service engagement, and its longitudinal evaluation survey to connect service engagement with smoking cessation outcomes. Findings of the most recent evaluation confirm that engagement with more service channels (phone service, online service and Txt2Quit) is associated with higher quit rates (The Quit Group, 2012). This is consistent with findings from the literature that online and mobile technologies can be more effective if supplemented by face to face approaches, and interventions that use more behaviour change techniques tend to have larger effects on behaviour than interventions that use fewer techniques (see Section 5.5).

6. Key lessons

The purpose of this report was to review the effectiveness of online and mobile technologies for changing health behaviours. This chapter summarises findings from reviews and New Zealand case studies to identify key lessons for enhancing the effectiveness of online and mobile-based health behaviour change interventions.

Opportunities

1. New Zealanders' use of the Internet, mobile phones, mobile devices and associated interactive technologies has grown exponentially in recent years, and will continue to grow.
2. Advances in Internet and mobile device use and capabilities provide a range of opportunities for health behaviour change. These include:
   - Enhanced ability to *reach* large populations
   - Enhanced ability to *access* target populations due to the widespread availability of the Internet, including 24/7 access via mobile devices
   - Ability to offer *interactive features* similar to those found in one-on-one counselling to large populations, via automated mechanisms
   - *Cost-effectiveness* due to the low-cost per user of Internet and mobile-based interventions and the scalability of these interventions.

Effectiveness

3. Internet-based interventions can have small but significant, short-term positive effects on health behaviours such as physical activity, diet, weight management and smoking cessation.
4. Mobile phone-based interventions can be effective but evidence of effectiveness is limited to text message-based smoking cessation interventions. There is little evidence for the effectiveness of interventions using other mobile technologies such as smartphones and apps.
5. There is limited evidence that online and mobile-based interventions can achieve long-term behaviour change.
6. There is limited evidence to confirm the widely held view that using online and mobile technologies to change health behaviours is cost-effective.
7. There is some evidence that the following features are associated with increased effectiveness of Internet-based interventions:
   - Use of automated, tailored feedback
   - Use of supplementary communication and one-on-one support
   - Use of theory
   - Use of multiple behaviour change and influence techniques.
8. Aside from evidence for the effectiveness of text messaging, there is little research on the features of mobile technology-based interventions that increase effectiveness.

Planning considerations

9. Online and mobile technologies should be used as part of a wider, integrated and theory-based intervention approach.
10. Online and mobile technologies should be used alongside other behaviour change tools such as additional communication channels and availability of personal support.
11. The objectives of online and mobile strategies should be clearly identified – distinguish between reach, awareness, engagement and action.

Research and evaluation

12. Plan to run interventions for long enough to establish and monitor long-term behaviour change.
13. Conduct the same formative research and process and outcome evaluation that would be conducted for traditional, mass media-based interventions:
    - Undertake target audience research and message testing
    - Monitor reach and engagement
    - Collect information on behaviour change in the target audience and, if possible, establish links between behaviour change and engagement with online and mobile channels.
14. Collect cost information.

In conclusion, there is evidence that online and mobile technologies can be effective for changing health behaviours and there are good reasons for using these technologies. However, little is known about which technologies are most effective and why. It is essential that interventions using online and mobile technologies are carefully planned, based on best available evidence, clearly articulated and evaluated.

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Appendix A: Key search teams for the literature review

- Meta-analysis
- Systematic review
- Review
- Obesity
- Diet
- Physical fitness
- Smoking cessation
- Internet / web
- Mobile / cellular / phone / smartphone
- e-health / ehealth
- Email / electronic mail
- Text messaging / SMS
- Social networking
- Facebook / twitter / tweet
- Social media
- Video conferencing

Appendix B: Key informant interviews

Representatives of the following organisations participated in key informant interviews:

- Health Promotion Agency (www.hpa.org.nz)
- Sport New Zealand (www.sportnz.org.nz)
- The Quit Group (www.quit.org.nz)
- GSL Network (www.gslnetwork.co.nz)
- Pacific Heartbeat, The Heart Foundation (http://www.heartfoundation.org.nz/programmes-resources/pacific-health/pacific-heartbeat-programme)
- Clinical Trials Research Unit, University of Auckland (www.ctru.auckland.ac.nz)

Appendix C: Glossary

App: An application that performs a specific function on a computer or mobile device. Apps range from Web browsers and games to specialised programmes like digital recorders, online chat or music players.

Automated: A feature of an online or mobile intervention that is built into the computer programme and actions automatically eg, reminder messages, tips, feedback based on individual monitoring.

Blog: An online journal that is updated on a regular basis with entries that appear in reverse chronological order. Blogs can be about any subject. They typically contain comments by other readers, links to other sites and permalinks.

e-Health: The use of electronic processes and communication in health care and public health.

e-Learning: The use of interactive electronic technologies to facilitate teaching and learning.

Email ('electronic mail'): A way of exchanging digital messages across the Internet or other computer networks.

Information and communication technology (ICT): Electronic technologies used for collecting, processing or transmitting information, which can be in the form of voice, images, or data. Examples of ICT include computers, the Internet, and telecommunications.

Interactive technologies: Digital technologies that enable users to interact with and influence content.

Internet: A global system of interconnected computer networks. It consists of millions of private, public, academic, business and government networks that are linked by an array of electronic, wireless and optical networking technologies. The Internet carries and provides the infrastructure for an extensive range of information resources and services, such as the World Wide Web, email, file transfer and instant messaging.

m-Health: The use of mobile computing and communication technologies (traditional mobile phones, PDAs, smartphones, tablets) in health care and public health.

Online chat: Real-time direct transmission of text-based messages over the Internet. Online chat includes web-based applications that allow communication between (often directly addressed, but anonymous) users in a multi-user environment. Instant messaging (IM) is a type of online chat that takes place between known users (eg, using a contact list).

Online gaming: A mechanism for connecting players together; online games are played over some form of computer network, typically the Internet. Many online games have associated online communities.

Online phone: Services that allow you to talk in real time over the Internet in a similar fashion to a phone call, often including a video component (eg, Skype, iTalk).

Social media: Social media are works of user-created video, audio, text or multimedia that are published and shared in a social environment, such as a blog, podcast, forum, wiki or

video hosting site. More broadly, social media refers to any online technology that lets people publish, converse and share content online.

Social networking services: An online service, platform, or site that focuses on facilitating the building of social networks or social relations among people who, for example, share interests, activities, backgrounds, or real-life connections. A social network service consists of a representation of each user (often a profile), his/her social links, and a variety of additional services. Most social network services are web-based and provide means for users to interact over the Internet, such as email and instant messaging. Examples include Facebook, Twitter, tumblr, Linked In and Google Plus.

Text message: Brief electronic message sent between mobile phones, containing text composed by the sender, usually input via a lettering system on a cell phone's numeric keypad.

Traditional media: Communication channels such as radio, television and print.

Websites: A set of related web pages served from a single web domain. A website is hosted on a server, accessible via a network such as the Internet. All publicly accessible websites constitute the World Wide Web.

Web 2.0: The second generation of the Web, which enables people with no specialized technical knowledge to create their own websites to self-publish, create and upload audio and video files, share photos and information and complete a variety of other tasks. In this new world, the Internet becomes a platform for self-expression, education and advocacy that "regular people" can use on their own without having to go to an expert to do it for them. Some of the best-known Web 2.0 websites include Wikipedia, MySpace, Digg, Flickr and YouTube.