

Uses and Benefits of SMS in Healthcare Delivery

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Discussion Paper

V 21.1.2005

Please note that this paper has subsequently been revised as part of ongoing research.

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1 Introduction

Mobile phones with SMS applications are increasingly used in interventions to deliver healthcare services. SMS has a number of attributes which makes it particularly suitable for use in health care. While SMS applications in health care have been described in individual studies, to date, no systematic reviews have explored how SMS text applications are used. We report findings of a systematic review on uses and benefits of SMS text applications in health care.

2 Methods

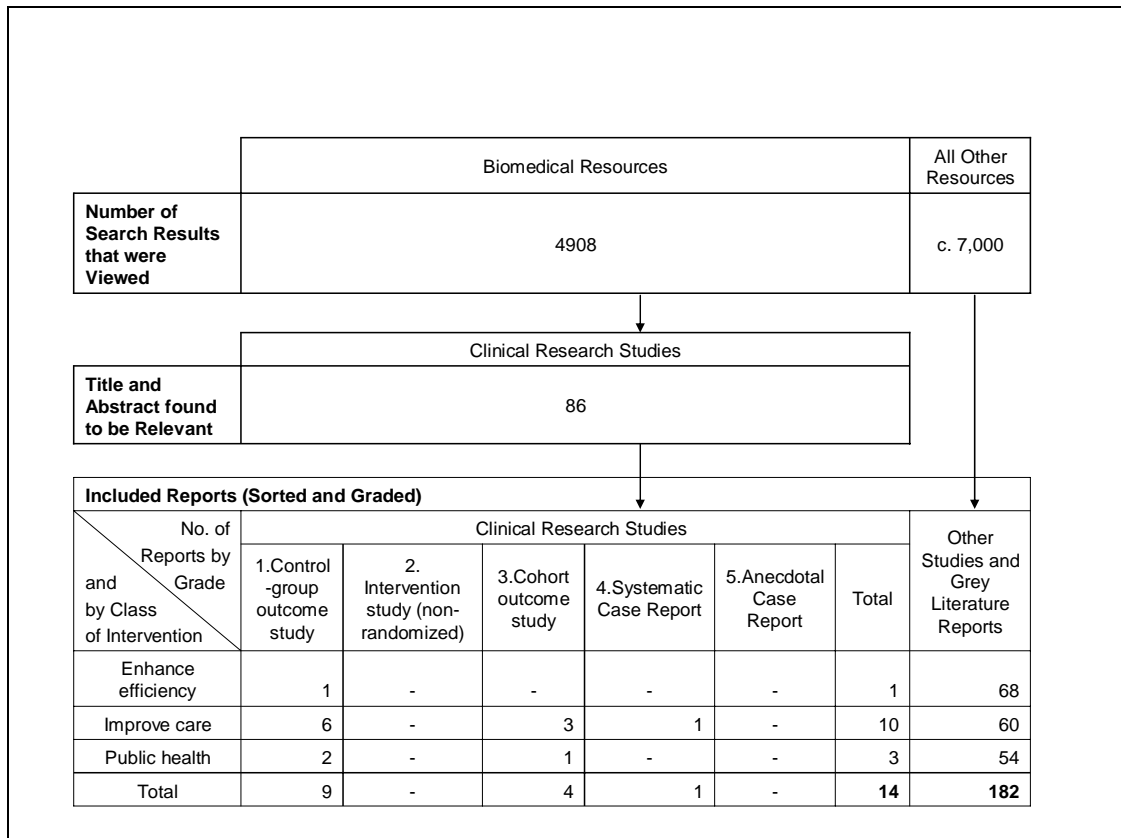
A systematic review involves use of internationally agreed methods to perform a detailed literature search, critical appraisal to assess the quality of the individual studies identified, and synthesis of the findings from these valid studies. This systematic approach limits bias and reduces chance effects, thus providing more reliable results upon which to draw conclusions and to inform decisions.¹

We conducted a systematic literature search in August and September 2005 according to systematic review guidelines to obtain a full set of clinical research studies. We identified eligible studies by a search for articles in biomedical databases (PubMed, EMBASE, CENTRAL). We performed separate hand searches in relevant journals, complemented by a search for unpublished studies on the ClinicalTrials.Gov register.

In addition, we extended our review by cascading references in the papers identified, by searching news, vendor and other reports of SMS applications in healthcare, as well as other grey literature sources, such as conference proceedings and PhD theses and key publications such as '101 things to do with a mobile phone in healthcare' by Wireless Healthcare and key websites such as www.textually.org to identify applications not tested in clinical studies: necessary, given that use of SMS applications in health care delivery is recent.

These resources were searched using free text and Boolean search terms; in addition, references of included articles were checked to identify further articles. Relevant articles, selected for inclusion, were appraised for quality and findings thematically synthesized.² The search strategy and terms used in the search are shown in Annex 1, while Figure 1 summarizes the search process and the number of articles identified and reviewed.

Figure 1: Search Process and Results



Our methodology, although rigorous, has limitations which may influence findings in that we only reviewed English language articles and limited our search of the grey literature to selected publications from key sources. We also sampled news and articles from vendor sites and were not able to review all of these news and articles undertaken. We were particularly interested in benefits of these applications and this limited the scope of our search. These factors may bias the findings and conclusions.

We present our findings by key areas of application segmented by three categories as (i) Experience to date (ii) Benefits reported in the grey literature, and (iii) Benefits described in clinical research studies published in peer reviewed journals

3 Uses of SMS to enhance efficiency of service delivery

3.1 Appointment Reminders

Missed appointments lead to substantial cost for many health systems but particularly for the national health system (NHS) in England. The costs are due to direct costs involved in arranging the appointment and the opportunity cost of missed appointments.

A survey of 683 general practice (GP) surgeries indicated that in 2005 around 10,234,361 GP and 4,949,517 practice-nurse appointments were missed and each year the number of missed appointments was increasing. In 84% of the practices surveyed missed appointments were a problem: this lengthened waiting times for GP appointments and adversely affected the ability of the practice to reach performance targets. A large majority of the GPs believed that patients missed appointments as they forgot they had an appointment. Almost all (98%) felt that missed appointments wasted NHS resources, while 87% felt these affected efficient running of the NHS – such was the feeling that 71% of the GPs would consider deregistering patients who repeatedly missed appointments, while many (66%) thought introduction of charges for missed appointments might help address this problem.³

Estimated cost of a GP appointment is £18, while that for nurse is £7.⁴ Therefore, in England, the annual direct cost of missed appointments to the NHS is £180 million for GP appointments and £34 million for practice nurse appointments.^{5,6} The figure for hospitals is even higher. The direct cost of missed hospital appointments, estimated to number 4.5 million⁷ to 6 million each year (or up to one in ten appointments), is estimated to be £575 million each year.⁸ Hence, in England, missed appointments cost the NHS £789 million a year. It is not surprising, therefore, to reduce the extent of the problem, the Department of Health (DOH) in England has issued a Missed Appointment Guidance, which identifies ways in which GP surgeries can improve attendance rates for hospital and GP appointments.⁹

3.1.1 Experience to date

In England, since 2003, a number of pilot trials, which use mobile phone SMS to remind patients to attend NHS appointments, have been launched.^{10,11,12,13}

In relation to the SMS-based reminders, there have been concerns regarding patient confidentiality, but these concerns have been addressed through an 'opt-out' scheme

which used an 'implied consent model': where patients were sent a leaflet informing of the scheme with an offer to opt out.¹⁴ In another pilot, patients were given an information leaflet – with a tear-off section that captured the date and time of the appointment and the mobile telephone number but without any other information which would identify the patient – which acted as consent.¹⁵ Others have questioned possible adverse impact on equity,¹⁶ which is unlikely given that mobile phones are equally used by all socio-economic groups.

Some of these pilots have already reported success or benefits (but without scientifically designed studies to conform these assertions)^{17,18,19} while others have identified organizational factors which enable or hinder uptake and diffusion of the SMS based reminders. Service uptake, which is negatively influenced by lack of administrative staff time to 'sell the benefits' of SMS reminders to patients and time taken to fill in forms, can be enhanced when clinicians are involved in 'signing up' patients to the scheme.²⁰ Additional time required to administer the scheme, perceived risk of human error, and systems which prevent access of temporary staff hinder uptake of these initiatives^{21,22,23}, while staff commitment, automation, multilingual-texting facility and training of the personnel involved in the scheme by the vendor improve acceptance.^{24, 25}

Patients who receive SMS reminders have tended to ignore subsequent paper-based communication, including those which included instructions to prepare for diagnostic investigations or therapeutic interventions.²⁶

SMS-based reminders are now used in appointments in imaging diagnostics²⁷, paediatrics²⁸, sexually transmitted illness^{29,30}, antenatal clinics³¹, adolescent health (for example for the morning after pill)³², mental health³³, dental services³⁴, rheumatology (to remind patients to attend urine and blood tests for drug monitoring)³⁵ and blood transfusions³⁶.

3.1.2 Benefits reported in the grey literature

A number of initiatives in England have reported benefits but these are not based on rigorous studies which are specifically designed to evaluate the impact of SMS reminders. In London, a scheme which used SMS text messaging for imaging diagnostics appointments reported positive patient experience and a reduction in the number of patients which did not attend (DNA) appointments, but the rate of decline was not quantified.³⁷ Whereas, in a pilot study in Cambridge, SMS reminders to patients

given dermatology clinic appointments led to 50% decline in the number of DNAs³⁸, a pilot in Leeds achieved 33% reduction in the number of DNAs to a hospital based sexual health clinic.³⁹ Other pilots have reported up to 40% reductions in DNAs for hospital outpatient appointments.⁴⁰ In primary care setting similar successes are reported. A trial, which involved two GP practices in London, reported 26% and 39% decline in the number of DNAs, with respective savings of £9,483 and £20,991 per annum.⁴¹ Net savings for the Islington Primary Care Trust, which manages a large number of practices in inner London, was estimated to be £471,158 per annum.

In the US, the rate of non-attenders for hospital outpatient appointments has been reported to be around 8% of the total, but outpatient clinics which use SMS-based appointment reminder systems report up to 30% reduction in DNA rates — even when the uptake SMS reminder service was as low as 20%.⁴² In Norway, a hospital-based SMS reminder system, which integrated with clinical administration systems of pilot GP practices, reduced hospital outpatient DNA rates by 14%.⁴³ Swedish experience of SMS reminder use in private dental and chiropractic clinics suggests that the number of DNAs can be reduced by up to 50%.⁴⁴

3.1.3 Benefits described in clinical research studies published in peer reviewed journals

In the Netherlands, a randomized control trial undertaken in an orthodontic clinic compared the effect on attendance rates of a reminder sent one day before the appointment using telephone, mail, or SMS text message with a control group which was not sent a reminder. The study found that reminders had no effect on attendance or cancellation rates, but the patients who were sent a reminder expressed negative feelings and felt the reminder was inappropriate use of resources.⁴⁵ However, it is difficult to extrapolate the findings from this study as the DNA rates at 4% were already very low as compared with levels in Northern Ireland (13.6%)⁴⁶ and England (23.3%).⁴⁷

3.2 Improving Communication between Healthcare Workers

Communication problems between health care professionals commonly lead to errors which adversely affect patient well being.⁴⁸

Much of the clinical information used by doctors come from peers, personal notes on patients or diagnostic tests.⁴⁹ Doctors prefer to seek opinion of experts rather than

consult guidelines, manuals or computer aided decision systems.^{50,51} For many health professionals, face to face communication or other interruptive methods (such as mail or telephone) are the preferred modes of information exchange.⁵²

3.2.1 Experience to date

SMS text messaging is now used to enhance communication between healthcare workers. For example, in England, the NHS E-mail and Directory Service offers e-mail and SMS text messaging for NHS employees.⁵³ Similarly, the Food Standards Agency's SMS text-based scheme alerts Food Enforcement Officers working away from office to warnings issued in relation to food – highlighting the urgency of the warning, the product name, and the action to be taken by local authorities.^{54,55}

3.2.2 Benefits reported in the grey literature

SMS messaging has been identified as a useful communication tool between surgeons with enhanced coordination of patient care, improved efficiency of administrative activities, greater accuracy of messages, and even increased responsiveness to urgent cases.⁵⁶

3.3 Monitoring Safety of Healthcare Workers

Health service workers often face threats to their personal safety due to abusive behaviour of patients, contact with biological hazards, and in natural disasters or accidents. In the NHS in England, over 95,000 instances of violent or abusive behavior towards NHS staff were reported in 2002-03.⁵⁷

3.3.1 Experience to date

An interesting SMS application has been developed in England where midwives use a mobile phone to inform a computer system of their location details at start of a visit. If there is no update within a certain time limit, the computer will generate an SMS text message to confirm safety of the midwife. If there is no response to the SMS, team leaders, managers or the police are contacted.^{58,59} Following the introduction of the system a large majority of the midwives said that they felt safer when working alone in the community.⁶⁰

3.4 Managing Queues

Long waiting times and queuing lead to customer dissatisfaction. Hence, efficient queue management is critical to improving service quality and user satisfaction.^{61,62,63}

3.4.1 Experience to date

A hospital in England has instituted a system whereby patients who are waiting to collect their dispensed drugs are sent an SMS message to inform them when their prescription is ready for collection.⁶⁴ This has provided much flexibility to the patients who do not have to waste time sitting and waiting and can return any time during the day to collect their medication.

3.5 Managing Temporary Human Resource Needs

3.5.1 Description & Lessons Learnt

In England, the NHS spends up to £1 billion a year employing temporary staff to meet staffing needs. Agencies which provide temporary staff to the NHS have established systems which match temporary staffing needs with available health workers and automatically send SMS text messages to check availability of temporary staff.^{65,66,67}

3.5.2 Benefits reported in the grey literature

SMS text messaging to contact temporary staff improves immediacy, accessibility and reduces costs for agencies and employers.⁶⁸

3.6 Improving administrative efficiency of health financing organizations

3.6.1 Experience to date

SMS interventions are being used to increase administrative efficiency in healthcare financing organizations. For example, in Philippines, the government Health Insurance Corporation has began to use SMS text messaging to inform its 64 million beneficiaries, including those who work abroad, of their status and entitlements.⁶⁹

3.6.2 Benefits reported in the grey literature

In India, a health insurance company which has launched an SMS facility for enquiries and alerts on claims reports cost savings and a reduction in claim processing time from 23 to seven days.⁷⁰

3.7 Contacting Blood Donors

3.7.1 Experience to date

SMS messaging is being used to invite teenagers to donate blood, and to collect information on blood groups of individuals to develop a database so that donors can be contacted in emergencies when blood (particularly of rare groups) is needed.^{71,72, 73,74}

3.7.2 Benefits reported in the grey literature

In India, when a Blood Centre issued an SMS based request to potential donors for blood to help a young patient with leukemia, 150 calls were received offering donations within an hour.⁷⁵

3.8 Enhancing access of disabled people

People with disabilities, such as those with deafness or those who are mute, can benefit from SMS-based applications to contact emergency services.⁷⁶

3.8.1 Experience to date

Text messaging services to contact emergency and health services have been launched in England⁷⁷, Northern Ireland⁷⁸, and Hong Kong.⁷⁹

4 Uses of SMS to improve diagnosis, treatment and rehabilitation of illness

4.1 Remote diagnosis

Experience with remote diagnostics using SMS applications is limited but SMS has been used in combination with a well-established monitoring system to estimate the severity of stutter in children living in rural Australia.⁸⁰

4.2 Improving Adherence to Health Advice and medication

Adherence is the extent to which patient actions are concordant with the advice given by his/her doctor or nurse. Non-adherence to prescribed treatment is estimated to be around 50%, but particularly problematic for long-term conditions which require daily medication.⁸¹ This leads to adverse health consequences for the patient and creates substantial costs to the health system as patients who do not adhere to their treatment are often hospitalised due to relapse of their condition and interruption of treatment for infections leads to emergence of resistant strains. Many individual- and therapy-related factors influence adherence, but a discussion of these is beyond the scope of this paper.

4.2.1 Experience to date

SMS reminders are used to prompt patients to take medication at the correct time and encourage completion of treatment regimens for a wide range of conditions, such as acne⁸², asthma⁸³, diabetes⁸⁴, tuberculosis⁸⁵, and AIDS⁸⁶, as well as to remind teenagers to take their contraceptive medication⁸⁷ and other patients to fill repeat prescriptions.⁸⁸

For patients, which have long-term conditions and have to regularly take medication, reminders need to be designed to retain user interest and avoid desensitization. Explanation of benefits at start of a scheme that uses reminders, personalized messages⁸⁹, different text messages each day⁹⁰, mixing reminders with alerts, jokes, and provision of lifestyle tips⁹¹ can all help retain interest in the reminder and improve adherence.

An innovative scheme in England, which has the highest rate of teenage pregnancies in Western Europe, used coded messages to ensure confidentiality when reminding teenagers to take their prescribed the oral contraceptive pill.⁹²

In South Africa, SMS reminders have been used to enhance adherence to treatment in patients with tuberculosis⁹³ and AIDS⁹⁴, but also in the latter to monitor treatment adherence levels. .

4.2.2 Benefits reported in the grey literature

A study which used Cell Phone Prompted Self Administered Therapy (PSAT) to improve adherence in tuberculosis patients treated according to World Health Organization

recommended protocol and to relieve staff work load reported that the scheme had reduced staff workload without adverse effect on cure rates and was welcomed by staff and the local health authority officials.⁹⁵

A cohort outcome study in Scotland in a cohort of 32 young adult asthma patients which used SMS text messages written in 'txtspk' from a fictitious friend 'Max' (e.g. "yo dude, it's max reminding U2 take ur inhaler") accompanied by a stream of celebrity gossip and horoscope messages was reported to be successful – with participants describing the service as acceptable, and reporting that they had developed a rapport with the fictitious character 'Max'.⁹⁶

4.2.3 Benefits described in clinical research studies published in peer reviewed journals

A double-blind randomized clinical trial in Spain, which involved 26 primary health care centers, analyzed the effect of printed information followed by two SMS text messages (on lifestyle or to reminds to take the medication), on adherence and lifestyle changes in patients with hypertension. Outcomes in the intervention group were compared with those in the control group which were not sent SMS text messages. Statistically, there was no difference in rate of non-adherence in both groups, which was around 15%, but the intervention group achieved better control of blood pressure and body weight reduction.⁹⁷

A case control study from Spain of patients given Hepatitis A and B vaccines levels compared adherence to immunization schedules in patients who received SMS text reminder for follow up vaccination with the control group who were not sent a reminder. The adherence level in the intervention group was higher than that in the control group and this difference was statistically significant.⁹⁸

In Australia, a randomized control trial involving HIV positive individuals receiving antiretroviral therapy compared adherence levels before and after an intervention which included one-to-one individualized patient education and regimen analysis, with a choice of a variety of aids to improve adherence to medication including a dosette box, SMS text messaging at each scheduled dose and programmable medication alarm. The results show that after the intervention there was a statistically significant decline in the number of missed doses as compared with pre intervention period.⁹⁹

4.3 Monitoring Illness and Medical Interventions

Effective monitoring of medical conditions, especially chronic illness, improves health outcomes and reduces health care costs.¹⁰⁰

4.3.1 Experience to date

SMS applications are being used in a variety of settings to enable monitoring of acute and chronic conditions as well as monitoring effect of medical interventions. For example a rheumatologist has implemented a reporting system that uses SMS messaging where patients who have had corticosteroid injections to inflamed joints of soft tissue report whether injections have been beneficial (for example in alleviating pain or improving movement). This has enabled remote monitoring and reduced need for follow up outpatient appointments, thereby reducing costs.¹⁰¹

SMS applications have also been used in South Africa to monitor HIV positive individuals receiving anti-retroviral drugs, where side effects are reported directly by patients to health workers.¹⁰² In Italy, SMS applications have enabled cancer patients to systematically report their symptoms to doctors from home: thereby reducing the need to be hospitalised for monitoring.¹⁰³ In England, France and Thailand, SMS messaging has enabled improved self-monitoring by diabetic patients and more regular reporting to clinicians.^{104,105,106}

4.3.2 Benefits reported in the grey literature

A novel application linked to monitoring of patients in intensive care involves nurses sending alerts to clinicians via SMS when certain changes are detected in the physiological status of the patient – the clinician is informed about status of critical patients more rapidly than with the use of pagers, thereby enabling more rapid response.¹⁰⁷

A cohort study in Denmark evaluated the feasibility and impact of using SMS messages to enhance self-care of asthma by reminding patients to take medication, note symptoms, measure peak flow rate and complete SMS-based asthma diary to send to clinicians. The study found that patients were able to use the SMS diary and were enthusiastic about it, as it gave them a greater sense of control over their condition.¹⁰⁸

4.3.3 Benefits described in clinical research studies published in peer reviewed journals

A randomized control trial, which compared an intervention group of patients who were asked to regularly monitor their asthma and send their peak flow results to their clinician on a daily basis via SMS with a matched control group who were advised to monitor but without SMS messaging, found that the symptom profile in the intervention group was significantly better than that in the control group. The intervention was found to be acceptable to patients.¹⁰⁹

A prospective intervention study which compared health outcomes in diabetic patients given a mobile phone to send SMS text message on their daily glucose level to a database with once weekly advice by clinicians with matched controls who received standard management (i.e. routine outpatient visit once every three months) was not able to demonstrate statistically significant difference in outcomes, but in a subgroup of patients who most actively used SMS, there was a small statistically significant improvement, which suggests that motivation to self-care is critical for the improvement of glycaemia control.¹¹⁰

In contrast, a prospective cohort study in Korea which trained diabetic patients to report their blood glucose levels via a web base system or SMS text and receive instructions on adjustment of medication dosage via the web showed that diabetes control (as measured by HbA1c level) had improved following the intervention as compared with levels at start of the study, and this improvement was statistically significant.¹¹¹ Another cohort study of diabetes management by SMS reported that overall user satisfaction and acceptance was very good, and additional costs were not high.¹¹²

4.4 Provision of Psychological Support

Management of certain conditions, such as bulimia, can be improved if there is continuity and immediacy of support from health professionals. In other conditions where interaction between the patient and the outside world is restricted (for example in immunosuppressed patients or those with an infection that requires isolation) support and interaction with other sufferers, family, friends and peers can have a beneficial therapeutic effect. SMS text messaging may be beneficial in such settings.

4.4.1 Experience to date

SMS interventions have been used to encourage young people to access counsellors to seek support on a range of issues, such as bulimia¹¹³, chronic illness¹¹⁴, managing stress during end-of-year exams¹¹⁵, and to receive advice on health¹¹⁶ or relationship problems.¹¹⁷

4.4.2 Benefits described in clinical research studies published in peer reviewed journals

A randomized controlled trial from Scotland used SMS text messaging to support young people with diabetes between clinic visits by providing a system called 'Sweet Talk' which utilizes a process of sequential goal setting to influence health behaviour, help patients set self-management goals and to improve glycaemic control. The study results show statistically significant improvement in diabetes control (as measured by metabolic control and self-efficacy) in the intervention group of patients using Sweet Talk, as compared with those who received standard care.¹¹⁸

A study, which focused on bulimia nervosa, employed observational methods and explored acceptability and feasibility of SMS based psychological support. The results suggest SMS intervention to be an appropriate intervention for providing aftercare following discharge from hospital.¹¹⁹

4.5 Communicating results of diagnostic tests

Traditional approaches used to communicate results are time consuming and inefficient as these often require the patients to return to the provider unit in person to receive the results.

4.5.1 Experience to date

SMS has been used in more developed countries to communicate results of in-vitro diagnostic tests (such as blood or microbiology tests)^{120,121,122,123} and radiological imaging such as breast cancer screening¹²⁴ or screening for sexually-transmitted infection.^{125,126} In less developed countries, where there are access barriers, SMS has been used to more efficiently send results to clinics in rural areas.¹²⁷

SMS has also been used to expedite communication to employers of occupational health examination results on foreign workers.¹²⁸

4.5.2 Benefits reported in the grey literature

Although reported benefits of using mobile phones and SMS text messaging to communicate results of diagnostic tests include reduced waiting times to inform patients,^{129,130} diminished costs to communicate normal results¹³¹ increased convenience for patients and providers with improved access and expansion in service use¹³², we could not identify any well-designed studies which reported benefits.

5 Uses of SMS in Public Health Programmes

5.1 Contact Tracing and Partner Notification for communicable diseases

Sexually transmitted infections (STIs) are a major public health problem in both industrialized and developing countries as the incidence and prevalence are both increasing. Partner notification (also termed partner management or contact tracing) is an important public health activity to control STIs, as the sexual partners of people with STI are likely to be infected but asymptomatic and not seek care.¹³³ SMS applications are being used to notify partners of individuals with STIs¹³⁴, but also to strengthen control efforts for major global public health problems such as tuberculosis, HIV and SARS.

5.1.1 Experience to date

A text alert service named “SARS Contact Tracing SMS” was launched by StarHub and the Singapore Tourism Board, to trace persons in case of future SARS outbreaks in Singapore.¹³⁵

5.1.2 Benefits reported in the grey literature

Clients attending an STI clinic in Melbourne found calls or SMS text messages to mobile telephones as acceptable and efficient means to contact their recent sexual partners, especially if provided with details of a web site which had information on the STI to which he/she had been potentially exposed.¹³⁶ Alternatively, the SMS message can be sent by the clinic to the client (or the index case) to be forwarded to their partner(s) – thereby maintaining the anonymity of the partner.¹³⁷

A case report in 2001 described how SMS text messaging was used to rapidly reach the partner of a client which had earlier attended the STI clinic and diagnosed to have an

infection. Although the partner was not aware of the reason why his girlfriend had attended an STI clinic, the SMS text message he received from her contained details of the diagnosis code: which was the used to initiate appropriate treatment. Thus SMS may be considered as an adjunct to contact slips for contact tracing in genito-urinary clinics.¹³⁸

5.2 Communicating Health Information to the Public

SMS is particularly useful for rapid communication of health information to the general public, for example for public health emergencies due to an outbreak of communicable diseases like meningitis, or particular client groups for example, when a large group of patients are inadvertently exposed to an infectious agent (such as hepatitis B, or HIV). It is also a very useful tool when large numbers of people need to be reached to rapidly recall harmful food products or pharmaceuticals.¹³⁹

5.2.1 Experience to date

In 2005, the ministry of health in Indonesia launched a hotline to enable the general public to rapidly report disease outbreaks, to lodge personal complaints about health services but also to receive and disseminate information on epidemics, such as SARS and avian flu¹⁴⁰ or natural disasters, such as tsunamis.¹⁴¹ Similarly, SMS is being used in Malaysia, South Korea and the UK to alert the public to natural disasters^{142,143,144} or to warn on food safety¹⁴⁵, to inform population in Spain of extreme weather conditions¹⁴⁶, and in Dubai to send health information to citizens.¹⁴⁷

SMS text messaging has also been used in public awareness campaigns in India to inform and educate the public on WHO tuberculosis control strategy^{148,149}, in Kenya Nigeria and Mali, to inform the public on HIV and malaria control programmes^{150,151,152,153}, or in Iraq to support a polio vaccination campaign targeting nearly 5 million children across the country.¹⁵⁴ During the SARS crisis a mobile operator in Hong Kong sent messages to citizens, informing them of precautions which helped reduce risk of exposure to SARS virus.¹⁵⁵

SMS-based mass messaging can also be used to effectively target particular geographic areas or population segments. For example, following floods in India, people in Mumbai exposed to flood waters were sent an SMS text messaging which advised them to

prophylactically take 200 mg of the antibiotic Doxycycline to prevent leptospirosis infection.¹⁵⁶ In the UK, NHS Direct Interactive uses SMS text messaging to provide health promotion advice and information to people with long-term conditions such as asthma and diabetes.¹⁵⁷ Similarly, other UK health organizations use SMS text messaging to target people in rural areas¹⁵⁸; provide health promotion information to students¹⁵⁹; confidential health information to school children¹⁶⁰ and teenagers¹⁶¹; sexual health advice^{162,163,164} and anti-smoking education to adolescents¹⁶⁵; mental health promotion to young people aged 15 to 25 years¹⁶⁶; information on pollen count to asthmatics¹⁶⁷ or hay fever sufferers^{168,169}; alerts on high levels of smog and air pollution to high risk groups.^{170,171,172}

SMS text applications are also being used to provide health education and promotion advice to people with obesity.¹⁷³

SMS applications are also used in other countries to target specific population segments and these include free as well as paid services. For example, a wireless sex education campaign was launched in Singapore over a ten day period where young people could send SMS text based questions to a panel of international doctors and pay a charge of \$3 per question answered.^{174,175} In China, specialists from Shanghai University provide, for a fee, information on acupuncture for various conditions.¹⁷⁶ In Korea, there are paid services which provide information to young people on women's health.^{177,178}

In Kenya, free information on questions related to HIV/AIDS are provided by an NGO to subscribers¹⁷⁹, whereas in Singapore, the National Kidney Foundation uses SMS to encourage uptake of screening services for kidney diseases by the general population.¹⁸⁰

Effective use of SMS in peer-to-peer communication of public health information, especially where there is inadequate information provided by the government, was illustrated during the SARS epidemic in China when the first case was discovered in Guangdong province and the epidemic quickly spread in the province. While the government and news agencies remained silent on the outbreak the news of the epidemic were transmitted instantly throughout the country via mobile phones, in particular with SMS messaging.¹⁸¹ This helped inform the international community and WHO on the extent of the epidemic but also created pressure on the government to act more decisively to combat SARS.^{182,183}

5.3 Use of SMS in Smoking Cessation Programmes

Over 1,300 million people in the world smoke tobacco.¹⁸⁴ Four-fifths of these live in low- or middle-income countries. WHO estimates that tobacco smoking killed around five million people in 2003 and if unchecked, will kill one billion people in the 21st Century.¹⁸⁵ The World Bank estimates that if adult tobacco consumption declined by 50% by the year 2020, approximately 180 million tobacco-related deaths could be avoided: hence the appeal of smoking cessation.¹⁸⁶ However, only a small percentage of cigarette smokers (1-3%) achieve lasting abstinence (at least 12 months) using willpower alone.¹⁸⁷ Thus public-health policies and interventions which encourage smoking cessation lead to welfare and economic benefits.

5.3.1 Experience to date

SMS has been used in Australia¹⁸⁸, New Zealand¹⁸⁹ Spain¹⁹⁰ and the UK¹⁹¹ to provide health education, anti-smoking campaigns and to assist behavioral change in people who are trying to quit smoking.

5.3.2 Benefits described in clinical research studies published in peer reviewed journals

A randomized control trial in New Zealand, which assessed the effectiveness of SMS text messaging in smoking cessation programmes found that a the number of people who stopped smoking in the intervention group were significantly higher than that in the control group which did not receive SMS text message based support.¹⁹² A follow-up study by the same team, found that this intervention was as effective for Maori as non-Maori participants.¹⁹³

A cohort study in the US, which assessed smoking cessation among college students using a Web and text-messaging programme,, reported comparable or superior cessation rates to those achieved in minimal-contact or self-help smoking-cessation interventions.¹⁹⁴

6 Conclusions

Studies from the grey literature and clinical studies published in peer reviewed journals demonstrate wide use of SMS-based applications with benefits in health outcomes. The

studies also show that SMS-based healthcare applications are acceptable to patients: suggesting SMS can be used to develop new service delivery models.

While the studies suggest economic benefits none of the studies reviewed have undertaken formal economic evaluations to quantify monetary benefits. However, extrapolating the findings from published studies one can estimate potentially substantial benefits. For example, studies from primary care setting in the UK report 26% to 39% decline in the number of DNAs, with respective savings of £9,483 to £20,991 per GP practice per annum. Further, net savings for the Islington Primary Care Trust, which manages a large number of practices in inner London, was estimated to be £471,158 per annum. In England, the annual direct cost of missed appointments to the NHS is £180 million for GP appointments and £34 million for practice nurse appointments. Hence, the reductions in the DNAs of 26% to 39% applied to England would translate to annual savings ranging from £55.6 million to £83.5 million.

In England, potential savings from reducing missed hospital appointments in the NHS are more substantial. Annual direct cost of missed hospital appointments in England is estimated to be £575 million each year. Pilot studies using SMS-based appointments have demonstrated 33% to 50% reductions in missed appointments. If such declines in missed appointments were generally achieved in England, this would translate to annual cost savings ranging from £190 million to £287.5 million.

Given the potential improvement in health outcomes and economic benefits there is a clear need to undertake well designed randomized clinical trials with economic evaluation alongside these to confirm clinical and economic benefits and to inform policy to develop novel service delivery methods which utilize SMS-based applications.

7 Annex 1: Search Strategy and the Search Terms Used

| | Biomedical resources: | Telecommunications resources: | Other resources: | Some highly-relevant resources: |
|-----------------------------------|---|---|--|--|
| Search strategy | <ul style="list-style-type: none"> ▪ Exhaustive search ▪ Biomedical reports only, so only mobile/SMS terms | <ul style="list-style-type: none"> ▪ Exhaustive search ▪ Telecommunications reports only, so only healthcare terms | <ul style="list-style-type: none"> ▪ 'Maximum variety sampling' ▪ Mobile/SMS terms <i>plus</i> healthcare terms | <ul style="list-style-type: none"> ▪ 'Maximum variety sampling' ▪ Full hand search |
| List of typical search terms used | <p>1. mobile telecommunication* OR SMS OR "text messaging" OR texting OR "short message service" OR "Cellular Phone"[MeSH][§]</p> | <p>2. patient* OR health* OR hospital* OR clinic* OR "primary care trust" OR surger* OR "general practitioner*" OR GP OR GPs OR "social care" OR "acute care" OR ambula* OR doctor* OR nurse* OR physician* OR surgeon* OR "medical practitioner*" OR "mental health" OR dentist* OR optician* OR pharmac* OR "walk-in centre" OR "NHS Trust"</p> | <p>[See left] 1. AND 2.</p> | Not applicable |
| Resource | <ul style="list-style-type: none"> ▪ Cochrane Database of Systematic Reviews ▪ Database of Abstracts of Reviews of Effects ▪ MEDLINE (Pubmed)[‡] ▪ EMBASE ▪ The Cochrane Central Register of Controlled Trials ▪ Bulletin of the World Health Organization ▪ British Medical Journal ▪ Current Controlled Trials | <ul style="list-style-type: none"> ▪ International Journal of Mobile Communications ▪ 160 Characters | <ul style="list-style-type: none"> ▪ Econlit (EBSCO) ▪ Business Source Premier (EBSCO) ▪ Web of Science ▪ Science Direct ▪ Factiva ▪ Google ▪ Google News ▪ Google Scholar Beta ▪ Association for Computing Machinery Portal ▪ Institute of Electrical and Electronics Engineers | <ul style="list-style-type: none"> ▪ Relevant categories of Textually blog ▪ '101 things to do with a mobile phone in healthcare' report ▪ Journal of Telemedicine and Telecare ▪ Conference proceedings found on ACM Portal and IEEE (see left) |
| Search results read | All hits | All hits | Typically the top 500-1000 hits | All |

[§] MeSH terms only apply to Pubmed.
[‡] Pubmed has a feature called 'Related articles' for each hit; these were also searched exhaustively.
Note: In all searches, where relevant reports had reference lists, these were checked to identify further reports that were relevant for inclusion.

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