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Text2PreventCVD: protocol for a systematic review and individual participant data meta-analysis of text message-based interventions for the prevention of cardiovascular diseases

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ABSTRACT

Introduction: Text message interventions have been shown to be effective in prevention and management of several non-communicable disease risk factors. However, the extent to which their effects might vary in different participants and settings is uncertain. We aim to conduct a systematic review and individual participant data (IPD) meta-analysis of randomised clinical trials examining text message interventions aimed to prevent cardiovascular diseases (CVD) through modification of cardiovascular risk factors (CVRFs).

Methods and analysis: Systematic review and IPD meta-analysis will be conducted according to Preferred Reporting Items for Systematic review and Meta-Analysis of IPD (PRISMA-IPD) guidelines. Electronic database of published studies (MEDLINE, EMBASE, PsycINFO and Cochrane Library) and international trial registries will be searched to identify relevant randomised clinical trials. Authors of studies meeting the inclusion criteria will be invited to join the IPD meta-analysis group and contribute study data to the common database. The primary outcome will be the difference between intervention and control groups in blood pressure at 6-month follow-up. Key secondary outcomes include effects on lipid parameters, body mass index, smoking levels and self-reported quality of life. If sufficient data is available, we will also analyse blood pressure and other secondary outcomes at 12 months. IPD meta-analysis will be performed using a one-step approach and modelling data simultaneously while accounting for the clustering of the participants within studies. This study will use the existing data to assess the effectiveness of text message-based interventions on CVRFs, the consistency of any effects by participant subgroups and across different healthcare settings.

Ethics and dissemination: Ethical approval was obtained for the individual studies by the trial investigators from relevant local ethics committees. This study will include anonymised data for secondary analysis and investigators will be asked to check that this is consistent with their existing approvals. Results will be disseminated via scientific forums including peer-reviewed publications and presentations at international conferences.

Trial registration number: CRD42016033236.

Strengths and limitations of this study

- This study uses a systematic approach to identify all potential trials examining the effectiveness of text messaging intervention for cardiovascular disease (CVD) prevention.
- The study will gather all available individual participant data (IPD) from previous trials for an IPD meta-analysis, which offers superior and more powerful analysis then convenient meta-analysis alone.
- The study will have sufficient data to compare the effects of text messaging across different subgroups.
- The Text2PreventCVD collaboration network would enable consensus from all the trialists to promote appropriate use of text messaging for CVD prevention.
- The resources, time and strong international collaboration required for such data analysis is a limitation.

INTRODUCTION

Non-communicable diseases (NCD), including cardiovascular disease (CVD) is the leading cause of death and disability in most parts of the world. During recent decades, the prevalence of CVD has increased in many low and middle income countries,[1]

causing significant premature mortality and morbidity. However, existing evidence indicates that a substantial proportion of the burden of CVD is avoidable through targeting cardiovascular risk factors (CVRFs) including smoking, high blood pressure (BP), lipids, diabetes, overweight and obesity and sedentary behaviours. CVD is a costly condition and has serious impact on individuals, families, society, health systems and nations as a whole. The WHO estimated that over three-quarters of all CVD mortality takes place in developing countries, which could be prevented with adequate lifestyle modification.[2] However, identifying low-cost, scalable and effective strategies to prevent CVD remains a major challenge in developed and developing countries.

In recent years, mobile health (mHealth) has gained increasing momentum with the potential to transform how we deliver healthcare, through scalability, affordability and personalisation.[3] Furthermore many people across all income groups own mobile phones, particularly in low-income countries where mobile phone usage is generally higher than fixed-line usage,[4] and as such mHealth interventions has the potential for substantial population impact. Using brief text messages to deliver CVD prevention support programmes via mobile phones is a potential exemplar.[5]

Several trials are currently being conducted of text message-based interventions in CVD prevention and management in different regions of the world.[6–9] Most of these trials do not have sufficient power and are not sufficiently large to examine generalisability across settings and patient subgroups, nor effects on longer-term clinical outcomes. While systematic review and meta-analysis can help establish generalisability and overall effectiveness, individual participant data (IPD) meta-analyses enables examination of common subgroup effects, for example by gender, age or education. In addition, a more detailed examination of the components of text message-based programmes is needed to inform translation of this research to practice. The details of intervention may not be published in a comparable way and therefore involving study investigators of the original studies will enable a more detailed comparison of text message-based intervention components.

This protocol aims to describe the steps that we plan to undertake to synthesise the existing data on text message-based interventions for CVD prevention using systematic review and IPD meta-analysis. The findings of this research have important implications for developing prevention programmes for CVDs in different contexts.

Objectives

Our overall objective is to establish a formal collaboration among several international groups conducting clinical trials of text message-based interventions in CVD prevention and facilitate the next generation of clinical trials in this area. The specific objectives are to:

1. Conduct a systematic review to identify relevant research teams and studies;
2. To invite teams to contribute data to conduct IPD meta-analyses;
3. To use IPD:
   A. To examine the effect of text message-based interventions on outcome measures;
   B. To investigate if the effects of text messages vary by patient characteristics (eg, sex, age group, socioeconomic group);
   C. To examine if the effect of text message-based interventions vary by intervention characteristics (eg, personalisation, frequency);
   D. To compare and contrast content characteristics of intervention programmes.

An important aim will be to examine the variation in effects of text-messaging interventions by key subgroups. There has been variation in the proportion of men and women recruited to some studies, and while this may be the nature of the disease conditions, it is unclear whether texting interventions are similarly effective in men and women. There is also the perception that there may be variation in use of mobile phones and mobile technologies in younger and older people, and variation by socioeconomic group. A recent trial using mobile phone text messages for improving adherence to retroviral medication showed that effects varied by education, gender, the timing of text messaging and interactivity.[10] Women, higher education and weekly text messages had significant positive interactions with text messaging. A study by Lester and colleagues reported from subgroup analysis that text messaging for antiretroviral treatment adherence worked better in males participants living in urban areas, and those who own a mobile phone.[11]

Another key aim is whether there is variation in effectiveness by intervention characteristics, specifically if more frequent messaging is beneficial, and whether intervention programmes that use personalisation are more effective.

METHODS

Systematic review and IPD meta-analysis will be performed according to Preferred Reporting Items for Systematic review and Meta-Analysis of IPD (PRISMA-IPD) guidelines.[12]

Inclusion criteria for selected studies

Studies will be included if they meet the following inclusion criteria:

- Study type: Randomised controlled trials (RCTs) of mobile phone Short Message Service (SMS) or text message intervention with a follow-up period of at least 6 months and a minimum 70% of completed follow-up of patients.
- Study population: Participants aged 18 years and older, both men and women will be included. There will be no limits on study participants in terms of ethnicity, religion, occupation, income and morbidities

such as, presenting with history of myocardial infarction or chronic heart diseases, CVRFs (diabetes, hypertension), cerebrovascular diseases or peripheral vascular diseases.

- Study focus: Only studies focusing on CVD primary and secondary prevention will be included.
- Intervention: Studies that involve the delivery of brief automated text messages (SMS) via a mobile phone device as the core component of the intervention. The intervention should be using at least any two of the behavioural techniques/strategies to achieve behaviour change, eg: education and reinforcement content. For example, interventions that focus only on medication reminders will be excluded. The mode of text message delivery can be a standard SMS or messaging apps like WhatsApp.[13]
- Sample size: A minimum total sample size of 30 participants. We have chosen to have a lower limit for sample size as we perceive the sample size to be a surrogate marker of study quality. Smaller sample size studies are more likely to be demonstration projects with less emphasis on rigour in recruitment and randomisation.
- Study setting: There will be no limits on study setting, that is, primary, secondary or tertiary care, community based or at patients' home.
- Comparator: Participants in the control group receiving standard-care (no messages or some form of control message).
- Language: Studies published in any language will be considered and translations will be sought, if required.
- Publication time: Studies published after 1990 will be considered. Studies prior to 1990 will not be included because mobile phones were mostly non-existent prior to this date (http://news.bbc.co.uk/2/hi/uk_news/2538083.stm).

Exclusion criteria:

Studies that included only clinic appointment reminders will be excluded. Web-based interventions without the use of mobile phones/SMS are outside the scope of this review. Also, studies targeted towards healthcare providers or other stakeholders rather than patients or consumers of healthcare services, and all studies where audio intervention or voice message is primary component will be excluded.

The criteria for including studies in the review can be summarised in the following PICOS format:

Population—Individuals (adults) of any demographic background;

Intervention—Mobile phone SMS or texting services;

Comparator—Intervention versus usual care;

Outcomes—Any two outcomes related to the prevention of CVD as follows: changes in BP, blood lipid levels, blood glucose, physical activity and diet;

Setting—Randomised controlled studies conducted in any setting (high, middle and low income countries according to United Nations (UN) Human Development (HD) index 2015; hospital or community based).

Identification of studies

Potentially eligible studies will be identified prospectively through using a range of methods, including extensive search of electronic database, trial registers, manual search of journals and the grey literature.

1. Electronic database: The following electronic databases will be searched: MEDLINE, the Cochrane Library, including Cochrane Central Register of Controlled Trials (CENTRAL); Cochrane Database of Abstracts of Reviews of Effects (DARE); the Cochrane Consumers and Communication Review Group Specialised Register; the EMBASE and PsycINFO (Ovid).
2. Trial registers: Ongoing, recently completed and unpublished clinical trials meeting the inclusion criteria described above will be identified from the following registers: for example, clinicaltrial.gov, The Australian New Zealand Clinical Trials Registry (ANZCTR), Pan-African and WHO-International Clinical Trials Registry Platform (ICTRP).
3. Other sources: In addition, the websites of relevant public and private organisations will be searched for publications in connection with the review's objectives. The list of such organisations includes, but is not limited to: WHO; the World Bank; World Economic Forum; and NCD Alliance. We will also review the grey literature including, Google Scholar, New York Academy of Medicine Grey Literature Report and any other relevant sources.

Screening and study selection

In order to conduct a comprehensive search, the following Medical Subject Headings (MeSH) search terms will be used: (1) intervention (text messaging, text messages, SMS, text message mobile phone, cellular phone, texting, SMS); (2) CVD (BP, hypertension, lipids, cholesterol, myocardial infarction, stroke, heart failure, arrhythmias, diabetes and obesity) and (3) study design (RCT). Advanced search, allowing for explosion search, searching keywords or browsing additional similar terms will be used whenever feasible.

Search results across electronic databases will be merged using reference manager software EndNote (Thomson Reuters Corporation, New York, New York, USA),[14] and duplicate records of the same study will be removed. Study selection will follow the process described in Cochrane Handbook of Systematic Reviews and PRISMA-IPD statements.[12] Two researchers (SMSI and KS) will independently screen titles and abstracts to remove irrelevant studies to identify studies that are meeting the inclusion criteria described above and extract data. Any disagreements will be resolved by consensus or in consultation with a third reviewer (CKC). Reference lists of the selected articles and reviews will be searched manually to identify additional relevant studies. Consultation and contacts with experts in this field will be made to help identify relevant studies. The

detailed search strategies are presented in online supplementary appendix 1.

Study outcomes

In accordance with the study research objectives we will perform IPD meta-analysis for the following outcomes from eligible trials (table 1).

Data management

We will seek data for all patients at all timepoints and grouped for the purpose of analysis: short term (6–12 months), medium term (13–24 months) and long term (>24 months). We will also seek individual key baseline patient demographic, anthropometric and clinical data (including age, gender, education, marital status, occupation, income, weight, height, systolic and diastolic BP, pulse rate, waist and hip circumference and race/ethnicity). For BP, we will request all the available BP data and take the mean of two values. Where three BP readings are available, we will discard the first reading and take the mean of the remaining two readings. Details of self-reported comorbidities and medication use will be collected. Where available, we will seek from investigators details at an individual participant level of the amount of physical activity/physical fitness and diet among other variables. If there is sufficient data, we will also report BP and other secondary outcome measures at 12 months. Information will be collected using a standardised questionnaire from all originator investigators and in-depth interview with investigators that is, qualitative methodology to better understand the process of development of the text messages, and how the intervention worked. The data collection form is annexed (see online supplementary appendix 2). We plan to compare the different behaviour technique taxonomy of the text message intervention in a separate paper using Michie's[15] behaviour change techniques used in interventions.

IPD meta-analysis

The principal investigators of the selected trials meeting the inclusion criteria will be invited by email to join the international consortium of Text2PreventCVD Trial Collaborators Group. Reminders will be sent after a week to non-responders, followed by approaching other investigators by email, phone calls, fax and other communication channels. Investigators will be requested to share their anonymised data after obtaining a signed agreement, preferably electronically using encrypted files and other secure data transfer technologies using standardised data collection forms. Data transfer will be via an encrypted data file sent by email or using a

Table 1 Study outcome, measurements and plans to unify the data

Study outcomes	Variables	Measurements	Plans to unify
Primary	The difference between intervention and control groups in SBP at 6-month follow-up	mm Hg	Mean SBP
Secondary	DBP at 6-month follow-up	mm Hg	Mean DBP
	BMI	kg/m^2	Mean BMI
	WC	cm	Mean WC
	HC	cm	Mean HC
	Smoking tobacco	Current or within the past 6 months	Proportion of current/ past smokers
	Physical activity	Sufficiently active/METS	Proportion of sufficiently active/mean METS
	Diet	Number of fruits and vegetables serving per week	Proportion
	QoL	Score	Mean score
	HbA1c	Percentage	Mean HbA1c
	Lipid parameters (LDL cholesterol)	mg/dL	Mean change
	CV events	Angina, myocardial infarction, stroke, arrhythmias, coronary heart diseases, valvular heart diseases, cardiomyopathy, etc	Number of events
	CV composite score	CV risk factors	Number of CV risk factors controlled with the intervention
	SBP and DBP at 12 months	mm Hg	Mean SBP and mean DBP

BMI, body mass index; CV, cardiovascular; DBP, diastolic blood pressure; HbA1c, glycated haemoglobin; HC, hip circumference; LDL, low-density lipoprotein; METS, Metabolic Equivalent of Task; QoL, quality of life; SBP, systolic blood pressure; WC, waist circumference.

password-protected drop box facility created for the project. Data will be stored in a secure computer server managed by the secretariat. Data collection, collation and analysis will be coordinated by the project secretariat based at the cardiovascular division of the George Institute for Global Health, Sydney, Australia.

Data merging and quality assurance

Data merging will be performed by a statistician at the George Institute for Global Health. Definitions of variables will be carefully checked to ensure that they are identical or whether recoding is required, this is carefully documented in a detailed analysis plan. The merged data set will be carefully checked. Data from each study will be evaluated and compared with the available publication(s). Each data set will be checked for the range of included variables to make sure that all values are reasonable and to identify missing values against the original publication. Attempt will be made to replicate results reported in the original publication, including baseline characteristics and outcome data at each available follow-up period, by reproducing the statistical methods as reported by the study authors. Any discrepancies or missing information between the results and those presented in each original publication will be discussed and clarified with the original study authors or principal investigators. Once data checks are complete and satisfactory, individual study data sets will be combined to form a new master data set with a variable added to indicate the original study. Copies of the master data set will be maintained by the project secretariat at The George Institute (TGI). Data from individual datasets will remain the property of the study collaborators who have provided IPD. The study protocol will be reported as per PRISMA Protocols (PRISMA-P) 2015 checklist: recommended items to address in a systematic review protocol[16] (see online supplementary appendix 3).

Statistical analyses

Data analyses will be conducted in accord with contemporary recommendations for IPD meta-analyses.[17–19] Data analysis will be performed using Stata V.12/SPSS V.20 (IBM Corporation, USA).

Descriptive and exploratory analyses will be used to identify and display differences in baseline characteristics between the types of patients enrolled in the trials, in particular, statistical comparisons of baseline means (using Student's t-tests) and prevalence's (using χ^2 tests) between different groups of patients. The rationale for performing these initial descriptive analyses is because an understanding of how patients differ between trials that might aid the interpretation of any apparent between-trial treatment differences that may arise. Study-level and patient-level characteristics of included studies will be presented. An interim meta-analysis of the systematic review is planned. This will allow considering the results of the studies which did not agree to share data for the IPD.

Analysis of primary end point: Our approach to the analysis of the primary outcome of the differences between intervention and control groups in systolic BP at 6 months will be by intention to treat. There are two methods of undertaking IPD meta-analysis: (1) using IPD to derive aggregate data for each study, followed by meta-analysis of the aggregate data ('two-step IPD meta-analysis') and (2) analysis of individual patient data using a mixed model and accounting for clustering of patients within studies ('one-step IPD meta-analysis'). In this project we will use one-step IPD meta-analysis, which is the most logistically demanding, but does allow for the most sophisticated modelling of covariates and has the best performance in terms of power.[17]

All randomised patients with outcome data will be included in the analysis. Time-to-event end points will be analysed using appropriate models which accommodate censored data (eg, Cox proportional hazards models). Continuous outcomes will be analysed using linear models with adjustments for baseline values. Appropriate models will be used, with a fixed effect on individual study and patient-level covariates, as well as a comparison of models with a fixed effect on intervention and random effects on intervention across trials.

Analysis of secondary endpoints: Changes in secondary outcome will be measured by one-stage or appropriate statistical method, as above. Heterogeneity will be assessed using the I^2 statistic from the two-stage meta-analysis and in the unlikely event it is very low or zero we will run a sensitivity analysis using standard general linear models (fixed effect).

Adjusted and subgroup analyses: This will be performed based on key baseline characteristics. Subgroup analyses will be displayed using forest plots. Any modification of treatment effects across predefined patient subgroups (ie, age, gender, socioeconomic group, ethnicity, etc), duration of SMS intervention[20] and trial geographical locality will be assessed by examining the significance of the subgroup by intervention interaction term within the model. The importance of the number of SMSs will be assessed by fitting the duration of intervention as a continuous variable and examining the interaction with intervention. Mediation analysis will be conducted to examine the association between changes in BP and health-related quality of life and clinical events.[19 21 22]

Sensitivity analyses: We will undertake a number of sensitivity analyses to test the robustness of conclusions. These will include: exclusion of studies from the primarily identified review that have a high risk of bias and trials with an overall SMS duration of <24 weeks. We will assess publication bias in this IPD meta-analysis in accord with the recommended methods.[23] Before performing the pooled analysis, we will assess the heterogeneity across studies using either the Cochrane Q statistic or the I^2 statistic.

When IPD cannot be obtained, the impact on meta-analysis conclusions will be investigated by including the aggregate data from those studies where IPD is unavailable. Where the inclusion of studies lacking IPD seem to have an important statistical or clinical impact, it may be helpful to compare the characteristics of the studies with IPD and those without to see whether there are key differences (eg, quality, length of follow-up, statistical methods). We will also assess funnel plot asymmetry (with and without studies using IPD) and perform Egger's regression test (for small study effect or publication bias). Additional research questions and other prespecified analyses will be performed as determined and agreed by the group members.

Analysis of other efficacy endpoints: To compare and contrast content characteristics of intervention programmes, we will conduct a separate review of the development of the various text-based interventions and a comparison of subsequent content characteristics and process evaluation. We will use a combination of quantitative and qualitative methodology to provide comparative data on the characteristics of intervention programmes.

Adverse events: Any adverse event reported in the trials will be extracted and analysed with number, percentage and difference between groups at the end of the trial.

Project management, coordination

The Text2PreventCVD Trial Collaborator Group refers to the core team of researchers who will oversee the strategic direction of the protocol; the 'Text2PreventCVD' refers to all those linked to the project and includes trial teams who have signed institutional agreements to provide data sets for the study.

Project secretariat

The Text2PreventCVD secretariat based at the cardiovascular division of the George Institute for Global Health will perform the following roles: act as a liaison between members of the collaborative group and agree to the research questions addressed by the collaboration and develop the initial protocol. Members of the collaborative group will be given opportunities to participate in decision-making regarding the study design and analyses and will have opportunities to network and identify future Text2Prevent research questions suitable for analysis. The secretariat will develop mechanisms for communication and input on methodological issues, agree to the data collection proforma; secure data handling; review the publication strategy for the collaboration; ensure that data are only used, and any additional research (including updating of the combined data sets with emerging evidence) only proceeds, following consultation and agreement with the group members; and lead future applications for research funding on behalf of collaborative group projects.

Data ownership and confidentiality

Participants in the individual trials have previously consented to participation in their respective trial. Given that the analyses proposed are simply an extension of the core analysis of the constituent trials, we do not anticipate that additional ethical permission will be required.

All trial data will be regarded as strictly confidential, and will not be provided to any third party without the prior written permission of the owners of the data. However, if appropriate, and agreed by the members, the same data set may be held elsewhere, and if so, strict confidentiality and data security at each data repository will be maintained. The secretariat will be responsible for collating and checking the data (in 1 location until complete, then will ensure that the final locked analysis data set is held in each data repository).

We will ensure that datasets shared as part of the project include no patient identifiable information (such as names and addresses), that all data storage is in accordance with the regulations governing research at TGI, and will obtain a signed data sharing agreement for 7 years with all authors to outline procedures for the transmission, storage, analysis and dissemination. The collaborators remain the custodians of their own data and retain the right to withdraw their data from the analysis at any time.

Publication policy

Recommendations will be followed for authorship in IPD analyses and multicentre studies.[24 25] Where possible, we will follow the policy of members of the collaborative group being listed as authors and names of other participating collaborators listed in the acknowledgements. All collaborators will be expected to participate fully in manuscript preparation and editing, and will be expected to consult with, and collate comments from, colleagues from the trials they represent. Requirements for authorship will follow those of the International Committee of Medical Journal Editors (http://www.icmje.org). A primary publication of the results of this review will be prepared by the secretariat. This and all other manuscript drafts will be circulated to the members of the group for comments, revision and approval.

Timeline and funding

All currently identified trials are fully or partially funded and have completed recruiting. We will formally invite all collaborators to an initial face-to-face meeting with the aim to prospectively document the protocol. We will seek funds to support collaborative meetings, statistical analyses and a partial support for a postdoctoral research fellow/statistician. The secretariat will prepare grant applications as appropriate for support and submit in the name of the group as a whole, including members of the group as co-applicants.

Ethics and dissemination

Ethical approval was obtained for the individual studies by the trial investigators from relevant local ethics committees. This study will include anonymised or de-identified data for secondary analysis and investigators will be asked to check that this is consistent with their existing approvals. Study data will not be used for any other purpose without the permission of collaborators. Members of the collaborative groups are listed at the end of this protocol. Results of the study will be disseminated in peer-reviewed publications and by international conference presentations.

DISCUSSION

Robust data on the effectiveness of mobile phone-based text messages intervention for CVD prevention is mostly not available. The vast majority of previous studies have been limited in sample size and single centre. This systematic review and IPD meta-analysis will provide an excellent platform for the next generation trials that are needed, testing further improvements in the intervention space and recruiting many times more participants internationally.

Strengthening CVD prevention is essential to reduce many cardiovascular outcome events and their complications including premature death and disability, which would ultimately lead to reduce healthcare costs, increase economic productivity and improve quality of life.[26] This collaboration provides an excellent opportunity to determine the consistency or otherwise of benefits of such interventions across varying healthcare systems, countries and whether other contextual factors modify the effects. Combining the data from these trials will offer insight into the overall effectiveness of text message-based support programmes. This approach has been used by several international collaborative groups including the Asia Pacific Cohort Studies Collaboration, the Single Pill to Avert Cardiovascular Events (SPACE) collaboration,[27] the Blood Pressure Lowering Treatment Trialists' collaborations led from the George Institute.[28] A formal collaboration also has the additional benefits of enabling systematically specifying components of the intervention programmes to facilitate reproduction and comparison, and providing further details about the context in which the programmes have been delivered to inform implementation. Investigators will also be invited to participate in a face-to-face conference meeting at the secretariat in Sydney for obtaining data and clarification. If any investigator or team fails to attend the face-to-face programme, they will be invited to join the meeting remotely using teleconference. Further efforts include informing networks of the proposed IPD and approaching investigators known to conduct similar studies to join the network as a part of ongoing programme.

The main benefits of an IPD meta-analysis include the ability to address some important outstanding questions, suggest new hypotheses and help identify future research questions. IPD meta-analysis offers superior and more powerful analysis then traditional meta-analysis. In addition to further increasing the precision of information on time to treatment, many outstanding questions about SMS intervention for CVD prevention will be informed by this collaborative meta-analysis. Robust data from an updated individual patient meta-analysis would provide the highest level of evidence, but consensus from all the trialists would be enormously helpful in promoting a substantial increase in the appropriate use of text messaging for the prevention of CVD. A limitation of this IPD meta-analysis is the retrospective data analysis. In addition, the resources, time and strong international collaboration required for such data analysis is another limitation.

CONCLUSION

This systematic review and IPD meta-analysis of SMS interventions will provide comprehensive evidence on the effectiveness of text messaging for CVD prevention in different settings and help to formulate CVD prevention policies and programmes.

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Contributors CKC, SMSI, JR and AR contributed to the study concept and design. CKC and SMSI participated in the drafting of the manuscript. All the

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REFERENCES

1. Zoghbi WA, Duncan T, Antman E, *et al*. Sustainable development goals and the future of cardiovascular health: a statement from the Global Cardiovascular Disease Taskforce. *J Am Heart Assoc* 2014;3:e000504.
2. Organization WH. Cardiovascular diseases (CVDs). Fact Sheet N 317. September 2011. 2015. http://www.who.int/mediacentre/factsheets/fs317/en/index.html (updated September 2009 and accessed on 5/11/2012).
3. Free C, Phillips G, Galli L, *et al*. The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review. *PLoS Med* 2013;10:e1001362.
4. Feder JL. Cell-phone medicine brings care to patients in developing nations. *Health Aff (Millwood)* 2010;29:259–63.
5. Chow CK, Ariyarathna N, Islam SM, *et al*. mHealth in cardiovascular health care. *Heart Lung Circ* 2016;25:802–7.
6. Redfern J, Usherwood T, Harris MF, *et al*. A randomised controlled trial of a consumer-focused e-health strategy for cardiovascular risk management in primary care: the Consumer Navigation of Electronic Cardiovascular Tools (CONNECT) study protocol. *BMJ Open* 2014;4:e004523.
7. Redfern J, Thiagalingam A, Jan S, *et al*. Development of a set of mobile phone text messages designed for prevention of recurrent cardiovascular events. *Eur J Prev Cardiol* 2014;21:492–9.
8. Neubeck L, Lowres N, Benjamin EJ, *et al*. The mobile revolution—using smartphone apps to prevent cardiovascular disease. *Nat Rev Cardiol* 2015;12:350–60.
9. Chow CK, Redfern J, Thiagalingam A, *et al*. Design and rationale of the tobacco, exercise and diet messages (TEXT ME) trial of a text message-based intervention for ongoing prevention of cardiovascular disease in people with coronary disease: a randomised controlled trial protocol. *BMJ Open* 2012;2:e000606.
10. Mbuagbaw L, van der Kop ML, Lester RT, *et al*. Mobile phone text messages for improving adherence to antiretroviral therapy (ART): an individual patient data meta-analysis of randomised trials. *BMJ Open* 2013;3:e003950.
11. Lester RT, Ritvo P, Mills EJ, *et al* Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. *Lancet Infect Dis* 376:1838–45.
12. Stewart LA, Clarke M, Rovers M, *et al*. Preferred reporting items for a systematic review and meta-analysis of individual participant data: the PRISMA-IPD statement. *JAMA* 2015;313:1657–65.
13. Montag C, Błaszkiewicz K, Sariyska R, *et al*. Smartphone usage in the 21st century: who is active on WhatsApp? *BMC Res Notes* 2015;8:331.
14. Reuters T. *EndNote*. New York: Thomson Reuters, 2011.
15. Michie S. Designing and implementing behaviour change interventions to improve population health. *J Health Serv Res Policy* 2008;13(Suppl 3):64–9.
16. Shamseer L, Moher D, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349:g7647.
17. Riley RD, Lambert PC, Abo-Zaid G. Meta-analysis of individual participant data: rationale, conduct, and reporting. *BMJ* 2010;340:c221.
18. Simmonds MC, Higgins JPT, Stewart LA, *et al*. Meta-analysis of individual patient data from randomized trials: a review of methods used in practice. *Clin Trials* 2005;2:209–17.
19. Taylor RS, Piepoli MF, Smart N, *et al*. Exercise training for chronic heart failure (ExTraMATCH II): protocol for an individual participant data meta-analysis. *Int J Cardiol* 2014;174:683–7.
20. Piepoli MF, Davos C, Francis DP, *et al*. Exercise training meta-analysis of trials in patients with chronic heart failure (ExTraMATCH). *BMJ* 2004;328:189–96.
21. Emsley R, Dunn G, White IR. Mediation and moderation of treatment effects in randomised controlled trials of complex interventions. *Stat Methods Med Res* 2010;19:237–70.
22. Burzykowski T, Buyse M. Surrogate threshold effect: an alternative measure for meta-analytic surrogate endpoint validation. *Pharm Stat* 2006;5:173–86.
23. Ahmed I, Sutton AJ, Riley RD. Assessment of publication bias, selection bias, and unavailable data in meta-analyses using individual participant data: a database survey. *BMJ* 2012;344:d7762.
24. Stewart LA, Tierney JF. To IPD or not to IPD?: advantages and disadvantages of systematic reviews using individual patient data. *Eval Health Prof* 2002;25:76–97.
25. Whellan DJ, Method for establishing authorship in a multicenter clinical trial. *Ann Intern Med* 2009;151:414–20.
26. Redfern J, Chow C. Strengthening preventive cardiology. *Heart Lung Circ* 2015;24:427–9.
27. Webster R, Patel A, Billot L, *et al*. Prospective meta-analysis of trials comparing fixed dose combination based care with usual care in individuals at high cardiovascular risk: the SPACE Collaboration. *Int J Cardiol* 2013;170:30–5.
28. Turnbull F. Effects of different blood-pressure-lowering regimens on major cardiovascular events: results of prospectively-designed overviews of randomised trials. *Lancet* 2003;362:1527–35.
29. Chow CK, Redfern J, Hillis GS, *et al*. Effect of lifestyle-focused text messaging on risk factor modification in patients with coronary heart disease: a randomized clinical trial. *JAMA* 2015;314:1255–63.
30. Bobrow K, Farmer AJ, Springer D, *et al*. Mobile phone text messages to support treatment adherence in adults with high blood pressure (SMS-Text Adherence Support [StAR]) a single-blind, randomized trial. *Circulation* 2016;133:592–600.
31. Bobrow K, Brennan T, Springer D, *et al*. Efficacy of a text messaging (SMS) based intervention for adults with hypertension: protocol for the StAR (SMS Text-message Adherence suppoRt trial) randomised controlled trial. *BMC Public Health* 2014;14:28.
32. Islam SMS, Niessen LW, Ferrari U, *et al*. Effects of mobile phone SMS to improve glycemic control among patients with type 2 diabetes in Bangladesh: a prospective, parallel-group, randomized controlled trial. *Diabetes Care* 2015;2015:e112–13.
33. Islam SMS, Lechner A, Ferrari U, *et al*. Mobile phone intervention for increasing adherence to treatment for type 2 diabetes in an urban area of Bangladesh: protocol for a randomized controlled trial. *BMC Health Serv Res* 2014;14:586.
34. Maddison R, Whittaker R, Stewart R, *et al*. HEART: heart exercise and remote technologies: a randomized controlled trial study protocol. *BMC Cardiovasc Disord* 2011;11:26.
35. Dale LP, Whittakar R, Jiang Y, *et al*. Text Message and Internet Support for Coronary Heart Disease Self-Management: Results From the Text4Heart Randomized Controlled Trial. *J Medi Intern Res* 2015;17:e237.
36. Dale LP, Whittaker R, Jiang Y, *et al*. Improving coronary heart disease self-management using mobile technologies (Text4Heart): a randomised controlled trial protocol. *Trials* 2014;15:71

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