APPENDICES

Appendix 1: Research protocol

Appendix 2: Participation information sheets and consent forms

Appendix 3: Interview topic guides

Appendix 4: Codebook
Appendix 1: Research protocol

Potential for the use of mobile health applications in the management of cardiovascular disease in Kerala: a qualitative study

*Keywords:* mobile health, m-health, mobile phones, cardiovascular disease, Kerala, qualitative

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Local Supervisor: Dr. Jaideep Menon (Cardiologist, Amrita Institute of Medical Sciences, Cochin, India)

Introduction

Cardiovascular diseases (CVDs) alone are responsible for a third of all deaths worldwide, thus posing a major threat to global health (1-3). Moreover, the disproportionate global burden of CVDs is projected to rise over the next fifteen years, in contrast to the declining burden of communicable, maternal, perinatal and nutritional diseases (4-6). India is no exception as its CVD epidemic continues to thrive. CVD is projected to become the largest cause of death and disability in India by 2020, with mortality rates increasing to a staggering 4.77 million deaths per year (7,8).

India’s deteriorating outcomes are magnified in the Indian state of Kerala. In 2011, CVD was responsible for nearly 40% of all deaths in a survey of 161,942 rural adults (9). Such a high mortality rate may be explained by the state’s CVD risk factor profile: 21.9% are tobacco users, 39.7% have poor dietary habits, 33.9% show abdominal obesity, 28.8% have hypertension, 14.8% have diabetes mellitus, and 54.1% have hyperlipidaemia (10). Not only do these risk factors predispose to CVD, but they also place populations at risk of other important non-communicable diseases (NCDs) such as cancers and respiratory disease; thus, it is of great interest to public health initiatives to develop methods of managing these risk factors in order to confront the rising threat of NCDs.

With 900 million subscriptions in 2013, India is the second largest user of mobile phones worldwide (11). A combination of the overwhelming popularity, economic feasibility and widespread network coverage of mobile phones in both urban and rural contexts offers plenty of opportunities for health care delivery. The concept of using mobile devices to support medical and public health has been dubbed ‘mobile health’ or ‘m-health’ by the World Health Organisation and has already been integrated into disease control worldwide (12). The majority of m-health applications currently focus on sexual health and communicable diseases such as HIV/AIDS, tuberculosis and malaria, with evidence showing that SMS interventions are both acceptable and appropriate in many populations (13).

Despite ongoing research concerning other important diseases, the need for CVD prevention and surveillance in developing countries is unparalleled yet overlooked (6,8,14-16), and the potential for the uses of m-health in both primary and secondary CVD prevention is vast: it can identify high risk individuals; it can aid drug adherence; it can provide reminders about lifestyle and behavioural change; it can monitor CVD risk factors; more generally, it can improve doctor-patient communication and improve health care accessibility. There are already several CVD m-health interventions being trialled around the world, albeit in high income countries rather than low-middle income countries (LMICs) like India. An ongoing randomised controlled trial in Australia using SMS interventions for secondary prevention of CVD has received positive feedback regarding acceptability, comprehensibility and usefulness of the intervention (17,18). A systematic review of trials using similar interventions for primary
prevention of CVD found insufficient evidence to determine the effectiveness of interventions in reducing overall CVD risk, but lacked generalisability to LMICs (19). It is evident that CVD is no longer a disease of wealthier populations, and so further research is needed concerning m-health in LMICs where the NCD burden is rapidly escalating.

Despite the lack of CVD-specific m-health research in India, recent literature has proved that health care delivery via mobile phones is acceptable and feasible in a rural Indian context (20,21). However, due to the presence of inter-state health disparities, it is important to obtain region-specific data in India; thus there is still a recognised need for in-depth qualitative research regarding the acceptability of m-health interventions in a particular context (20-23). Throughout the literature, it is undisputed that m-health has enormous potential for revolutionising health care delivery in all settings; it is now the duty of researchers to explore and refine m-health services to suit specific populations to produce effective health interventions. This qualitative study will explore the perceptions of three different stakeholder populations concerning the potential uses of m-health and its acceptability in a Keralan context. It aims to look at management of CVD as a whole to explore where stakeholders think the greatest need for intervention is; whether in targeting CVD risk factors to prevent the development of acute CVD (primary prevention) or in managing established CVD (secondary prevention). This research will be carried out in conjunction with a quantitative survey addressing the acceptability and potential for use of mobile phones in CVD health care, and both studies will act as pilots for a large randomised trial using SMS intervention to improve primary prevention of acute CVD in high risk individuals.

**Aims & Objectives**

The aim of this research is to explore the potential for using m-health applications to manage cardiovascular disease in Kerala, India. This will be achieved by exploring: the experiences and perceived challenges in the current management of CVD; the current use of mobile phones; and the expectations, perceptions and barriers of using mobile phones for CVD management.

**Design**

This research will use both interviews and focus groups. Qualitative methodology is appropriate for rigorous exploration of personal experiences and expectations, generating rich, in-depth information relating to the topic (24).

**Setting**

The setting for this research is in the Ernakulam district of Kerala. Within Ernakulam district, this study will look at individuals from five adjacent panchayats (village districts) – Mookkannur, Karukutty, Manjapra, Thuravoor and Kalady. The Epidemiology of Noncommunicable Diseases in Rural Areas (ENDIRA) study, currently in press (25), conducted a survey of over 100,000 individuals from this area and identified those with CVD risk factors.

**Sample**

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<th>Inclusion Criteria</th>
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<td>ASHAs</td>
<td>• employed in one of the five panchayats</td>
<td>• no specific exclusion criteria</td>
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<td>• involved in care of patients with CVD risk factors</td>
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<td>• access to mobile phone</td>
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A total of fifteen participants will be sampled from three key stakeholder populations in Ernakulam, resulting in the recruitment of five participants from each stakeholder population: (i) accredited social health activists (ASHAs) (ii) physicians treating CVD (iii) CVD patients with CVD and/or risk factors.

(i) ASHAs. Kerala state employs ASHAs as community health care workers to link the community with primary health care services. Firstly, five ASHAs will be recruited from the network of 75 ASHAs identified by the ENDIRA study (25), one ASHA from each of five panchayats. ASHAs are all female, literate and of a similar age (26); thus, due to limited variation of ASHAs, convenience sampling will be used.

(ii) Physicians. One physician involved in the care of a patient with CVD will be conveniently sampled from each of the five panchayats.

(iii) Patients. One patient will be sampled from each of the five different panchayats. Maximum variation sampling will aim to recruit five patients with varying demographics, CVD risk factors, and whether or not they have established CVD.

Malayalam is the official language of Kerala, although English is widely used in both education and social situations in both urban and rural contexts (27). Kerala has an impressive literacy rate of around 96% (27) and participant information sheets and consent forms will be provided in both languages to account for the participant’s literacy preferences. Doctors speak English fluently, whereas patients and ASHAs are more comfortable conversing in Malayalam. Thus, a bilingual research assistant, who is not a participant in the study, will translate the interviews/ focus groups for patients and ASHAs and assist the researcher with any linguistic issues that arise during participant contact. The research assistant will be trained for several different roles, which will be described in further sections of this protocol, and sign a confidentiality agreement [appendix 1].

Recruitment
The research assistant will make the initial contact with all eligible participants by telephone. Participants will be informed on the nature and intent of the research and invited to participate. If participants express an interest in the study, the researcher and research assistant will meet them as soon as possible at their place of employment (ASHAs and physicians) or at home (patients) in order to start to build a rapport with participants, provide further information on the study (including withdrawal procedures and local contact details) and obtain written consent [appendix 2]. Consent will be gained by the researcher before enrolment into the study. If the participant is literate only in Malayalam, the research assistant will take consent. Fifteen participants will be recruited in total. Ideally, more participants would be recruited in order to ensure data saturation, which is the point at which no new ideas

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<th>Patients</th>
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<td>• access to mobile phone</td>
<td>• involved in CVD patient care</td>
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<td>• at least one CVD risk factor</td>
<td>• access to mobile phone</td>
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<td>• prescribed at least one CVD drug</td>
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<td>• fluent in Malayalam and/or English</td>
<td>• physical or mental disability</td>
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emerge from subsequent data collection (24). However, the time constraints of the research limit the number of participants recruited to fifteen.

Data Collection and Storage

Convenient dates for interviews/focus groups will be arranged after consent is given and participants will be reminded of their upcoming interviews/focus groups by telephone three days prior. All interviews/focus groups will: (i) be led by the researcher (ii) be conducted in English (iii) have a research assistant present for linguistic issues (iv) be audio-recorded using a Dictaphone (v) last around thirty minutes each (vi) take place in a private room in the local community health centre. All participants will be financially reimbursed for travel expenses. Field notes from interviews and focus groups will be recorded immediately in order to aid analysis and provide context.

Each participant will be interviewed separately by the researcher in one face-to-face, semi-structured interview. Semi-structured interviews allow the collection of rich, in-depth data relating to the research questions, while still maintaining flexibility to probe and expand on ideas (24). Topic guides are developed from previous qualitative literature concerning m-health applications (28-30) and will vary depending on the stakeholder group of the participant [appendix 3]. Broadly, the interview will explore three main areas: (i) the experiences and challenges of current CVD management (ii) how mobile phones are currently used on a daily basis (iii) ideas, perceptions and expectations of a potential CVD management mobile phone application.

Three to five weeks post-interview, participants will form a focus group consisting of the other four recruited members of their stakeholder population. Thus there will be three focus groups: one for ASHAs, one for physicians, and one for patients. Focus group discussion will facilitate interplay between the different stakeholders and may lead to both the emergence of novel themes and the recurrence of old themes (24). The topic guide for focus groups will again cover the three areas discussed during interviews [appendix 4] but may be adapted in the field to allow further discussion of themes generated from all interviews. Any themes from interview data will be discussed broadly, anonymised and exclude direct quotations in order to protect participant confidentiality.

Audio-recordings will be transcribed and stored on an encrypted hard-drive and a secure University of Birmingham server before deleting the original recording from the Dictaphone as soon as possible. Consent forms will be photographed and uploaded onto the same encrypted hard-drive before hard copies are destroyed and photographs deleted from the camera. A file of participants’ contact details will also be stored on an encrypted hard-drive. Transcribed data will be anonymised to maintain identity confidentiality. Upon return to the United Kingdom, research data will be stored on a University server. University regulations advise that research data be preserved and accessible for up to ten years after research completion (31).

Analysis

Interviews will be transcribed verbatim and anonymised before being uploaded onto Nvivo (a qualitative software data programme) and analysed by the author using thematic analysis, as described by Braun and Clarke (32).

Firstly, transcripts will be read thoroughly and annotated. Data will then be broken down and derived into codes, before codes are linked and structured into themes (33). In order to allow emerging themes to be developed and tested, constant comparison will be employed throughout analysis: between interview data; between focus group data; and between focus group and interview data. The latter, as a method of triangulation, aims to increase the validity of the research if the themes developed from different methods of data extraction are consistent (24). Furthermore, respondent validation will be used to allow participants to corroborate any findings, encouraging the
researcher to practice reflexivity during analysis (34). Reflexivity will aim to minimise potential biases in data interpretation by continuous evaluation of the researcher’s influence on the analytical process.

**Ethical Approval**

Ethical approval will be sought from BMedSc Population Sciences and Humanities Internal Ethics Review Committee at the University of Birmingham and the ethics committee at the Amrita Institute of Medical Sciences in Cochin, India. Ethics approval has already been applied for in India and this ethics review meeting will take place in Cochin on the 24th January 2015. Ethical approval is required from both committees because the proposed methodology of data collection involves human participants outside the United Kingdom.

**Feasibility**

Prior to the research, a pilot study will allow for the reviewing of the interview schedule to improve cultural appropriateness and understanding of questions following a trial on a patient, ASHA and physician. Recruiting patients and ASHAs should be feasible on account of the high prevalence of CVD and its risk factors in this population, in addition to the ENDIRA study authors stating that their network of 75 ASHAs were co-operative during their research (25). Physicians may be more difficult to recruit as they are fewer in number and may not have the time nor the desire to participate. The proposed timetable and relatively low costs of the research over an eight week period mean that the study is both practically and financially feasible [appendix 5]. Participant information sheets and consent forms will be translated and produced at the Amrita Institute of Medical Sciences and checked for understanding during the pilot study.

**Acknowledgements**

I would like to acknowledge Drs. Amitava Banerjee and Jaideep Menon for their continuing support and advice in constructing this research project, as well as Dr. Antje Lindenmeyer for all her help regarding qualitative methodology.

**Lay Statement**

Cardiovascular disease (heart attack and stroke) is a growing epidemic in India. In the state of Kerala, 40% of all deaths in 2011 were caused by cardiovascular disease alone. Reasons for such a high death toll may be due to the high rates of smoking, obesity, high blood pressure, high cholesterol and diabetes – all predisposing to cardiovascular disease. Also evident in India is the overwhelming popularity and widespread accessibility of mobile phones. Mobile phones have the potential to be a revolutionary source of health care delivery, and disease management schemes now need to harness the ubiquity of mobile phones towards improving health. This could involve the dissemination of health information, reminders to take medication or sending in blood pressure readings. This research will recruit patients, doctors and healthcare workers, exploring their views and expectations of the current management of cardiovascular disease, how they currently use mobile phones, and how mobile phones could be used in future disease management. This data will be extracted using interviews and focus groups before being analysed for common themes. With these findings, we can start to grasp where mobile phones have the most potential in improving cardiovascular disease in Kerala and combat these escalating trends.
References


Potential for the use of mobile health applications in the management of cardiovascular disease in Kerala: a qualitative study

[Informed Consent Form for ASHAs]

Part I: Information Sheet

Dear Participant,

I am a medical student from the University Of Birmingham, England. As part of my degree, I am conducting research relating to international health.

I would like to invite you to take part in my research study. Before you decide, I would like you to understand why the research is being done and what it would involve for you. Either myself or the research assistant (who made the initial contact with you by telephone) will go through this information sheet with you and answer any questions you have. We suggest this will take about 20 minutes.

Purpose and Intent of Research

This research will explore how mobile phones can be used to support public health, a concept known as mobile health. I am specifically interested in cardiovascular disease (CVD) and its risk factors. Risk factors for CVD include high blood pressure, high cholesterol, obesity, diabetes, smoking and physical inactivity. I would like to find out what you think the current challenges are of managing CVD and its risk factors and what potential role mobile phones may have in managing the disease in the future.

Participant Selection

I believe your experience as an Accredited Social Health Activist (ASHA) looking after patients in your panchayat with CVD and/or CVD risk factors means that your thoughts are extremely valuable to my research. You have also been chosen because you can speak English and have access to a mobile phone.

Procedures

If you choose to participate, you will be asked to take part in both:

1. An interview, on your own
2. A focus group, with four other ASHAs

I will ask you to discuss your views on current CVD management, how you use your mobile phone in your daily life, and how you think mobile phones could be used to improve CVD care. The interview will take place first, followed by the focus group about 3-5 weeks later, with each session lasting about thirty minutes. You shall be reminded of your upcoming sessions three days before via telephone. Both sessions will be led by me and questions will be asked through a translator. Both will be conducted in a
private room in your local community health centre. You will be reimbursed on the day of your interview/focus group in cash for any travel expenses incurred – please provide your receipts used for travel to the health centre.

Confidentiality

Discussions will be audio-recorded and no-one else apart from myself will have access to the recorded information. Recordings will be uploaded and transcribed onto a password-protected computer and deleted off the recording device as soon as possible. All of your data will remain anonymous and I will not be sharing information about you to anyone outside the research team.

It is difficult to ensure confidentiality in focus groups due to the presence of other participants. Please respect the confidentiality of other members of the focus group by not sharing the information discussed in the focus group with others.

Voluntary Participation and Right to Refuse or Withdraw

Your participation in this research is entirely voluntary and you do not have to share any information or answer any questions that make you feel uncomfortable. It is your choice whether to participate or not and the choice that you make will have no effect on your job or job-related evaluations. If you choose to participate and later change your mind, you are free to withdraw from the research without giving any reason up to a week after the focus group. You may do so by contacting me using the contact details given below. If you choose to withdraw during/after focus group, your interview data will be excluded and destroyed. However, we cannot withdraw the data you provide in the focus group and this may still be analysed and included in the research.

Sharing the Results

After the research has been conducted, you will receive a summary of the results and have the opportunity to make sure your views have been accurately interpreted. There is a chance that the results of the research will be published so that others may learn from the research. You will not be identified in the published data.

Who to Contact

If you have any questions, you can ask them now or later. If you wish to ask questions later, or you wish to withdraw from the research, you may contact the following:

Name: Rebecca Smith

Local telephone number: [local phone number not yet known]

E-mail: rxs189@bham.ac.uk

If you have a concern about any aspect of this study, you should ask to speak to the research supervisors:

Jaideep Menon (Amrita Institute of Medical Sciences, Cochin, Kerala): menon7jc@gmail.com

Amitava Banerjee (University of Birmingham, United Kingdom): a.banerjee.1@bham.ac.uk
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[Informed Consent Form for Patients]

Part I: Information Sheet

Dear Participant,

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Participant Selection

I believe your experience as a patient with established CVD and/or CVD risk factors (as listed above) means that your views are extremely valuable to my research. You have also been chosen because you are being prescribed at least one drug to prevent CVD, you can speak English and you have access to a mobile phone.

Procedures

If you choose to participate, you will be asked to take part in both:

1. An interview, on your own
2. A focus group, with four other patients

I will ask you to discuss your views on current CVD management, how you use your mobile phone in your daily life, and how you think mobile phones could be used to improve CVD care. The interview will take place first, followed by the focus group about 3-5 weeks later, with each session lasting about thirty minutes. You shall be reminded of your upcoming sessions three days before via telephone. Both
sessions will be led by me and questions will be asked through a translator. Both will be conducted in a private room in your local community health centre. You will be reimbursed on the day of your interview/focus group in cash for any travel expenses incurred – please provide your receipts used for travel to the health centre.

Confidentiality

Discussions will be audio-recorded and no-one else apart from myself will have access to the recorded information. Recordings will be uploaded and transcribed onto a password-protected computer and deleted off the recording device as soon as possible. All of your data will remain anonymous and I will not be sharing information about you to anyone outside the research team.

It is difficult to ensure confidentiality in focus groups due to the presence of other participants. Please respect the confidentiality of other members of the focus group by not sharing the information discussed in the focus group with others.

Voluntary Participation and Right to Refuse or Withdraw

Your participation in this research is entirely voluntary and you do not have to share any information or answer any questions that make you feel uncomfortable. It is your choice whether to participate or not and the choice that you make will have no effect on the medical care you receive. If you choose to participate and later change your mind, you are free to withdraw from the research without giving any reason up to a week after the focus group. You may do so by contacting me using the contact details given below. If you choose to withdraw during/after focus group, your interview data will be excluded and destroyed. However, we cannot withdraw the data you provide in the focus group and this may still be analysed and included in the research.

Sharing the Results

After the research has been conducted, you will receive a summary of the results and have the opportunity to make sure your views have been accurately interpreted. There is a chance that the results of the research will be published so that others may learn from the research. You will not be identified in the published data.

Who to Contact

If you have any questions, you can ask them now or later. If you wish to ask questions later, or you wish to withdraw from the research, you may contact the following:

Name: Rebecca Smith

Local telephone number: [local phone number not yet known]

E-mail: rxs189@bham.ac.uk

If you have a concern about any aspect of this study, you should ask to speak to the research supervisors:

Jaideep Menon (Amrita Institute of Medical Sciences, Cochin, Kerala): menon7jc@gmail.com

Amitava Banerjee (University of Birmingham, United Kingdom): a.banerjee.1@bham.ac.uk
Potential for the use of mobile health applications in the management of cardiovascular disease in Kerala: a qualitative study

[Informed Consent Form for Physicians]

Part I: Information Sheet

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Participant Selection

I believe your experience as a physician caring for patients with CVD and/or CVD risk factors means that your views are extremely valuable to my research. You have also been chosen because you can speak English and have access to a mobile phone.

Procedures

If you choose to participate, you will be asked to take part in both:

1. An interview, on your own
2. A focus group, with four other doctors

I will ask you to discuss your views on current CVD management, how you use your mobile phone in your daily life, and how you think mobile phones could be used to improve CVD care. The interview will take place first, followed by the focus group about 3-5 weeks later, with each session lasting about thirty minutes. You shall be reminded of your upcoming sessions three days before via telephone. Both sessions will be led by me, in English, with the research assistant present for any language issues. Both
will be conducted in a private room in your local community health centre. You will be reimbursed on the day of your interview/focus group in cash for any travel expenses incurred – please provide your receipts used for travel to the health centre.

Confidentiality

Discussions will be audio-recorded and no-one else apart from myself will have access to the recorded information. Recordings will be uploaded and transcribed onto a password-protected computer and deleted off the recording device as soon as possible. All of your data will remain anonymous and I will not be sharing information about you to anyone outside the research team.

It is difficult to ensure confidentiality in focus groups due to the presence of other participants. Please respect the confidentiality of other members of the focus group by not sharing the information discussed in the focus group with others.

Voluntary Participation and Right to Refuse or Withdraw

Your participation in this research is entirely voluntary and you do not have to share any information or answer any questions that make you feel uncomfortable. It is your choice whether to participate or not and the choice that you make will have no effect on your job or job-related evaluations. If you choose to participate and later change your mind, you are free to withdraw from the research without giving any reason up to a week after the focus group. You may do so by contacting me using the contact details given below. If you choose to withdraw during/after focus group, your interview data will be excluded and destroyed. However, we cannot withdraw the data you provide in the focus group and this may still be analysed and included in the research.

Sharing the Results

After the research has been conducted, you will receive a summary of the results and have the opportunity to make sure your views have been accurately interpreted. There is a chance that the results of the research will be published so that others may learn from the research. You will not be identified in the published data.

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If you have a concern about any aspect of this study, you should ask to speak to the research supervisors:

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Amitava Banerjee (University of Birmingham, United Kingdom): a.banerjee.1@bham.ac.uk
Potential for the use of mobile health applications in the management of cardiovascular disease in Kerala: a qualitative study

Part II: Consent Form for Participants

- I confirm that I have read and understand the information sheet version 3.1 for the above study.

- I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

- I understand that my participation is voluntary and that I am free to withdraw up until a week after the focus group without giving any reason.

- I agree to take part in the above study.

Print Name of Participant: ________________________________

Signature of Participant: ________________________________

Date (DD/MM/YY): __________________________

Print Name of Person Gaining Consent: ________________________________

Signature of Person Gaining Consent: ________________________________

Date (DD/MM/YY): __________________________
Appendix 3: Interview topic guides

Interview topic guide for ASHAs

Introduction:

As you know, we are currently looking into ways in which mobile phones can be used to help support those living with cardiovascular disease (CVD) and/or its risk factors in order to better manage their condition. We would like to explore your views on the current management of CVD and the potential for the use of mobile phones in this aspect. If at any point you do not wish to answer any of the questions, you may say so and I will move on to the next question. You are free to terminate the interview at any point, in which case the data you provide will be erased. Do you have any questions before we begin?

Current CVD management:

• What is your current role in managing patients with CVD and/or CVD risk factors?
• How do you feel about the amount of contact you have with patients?
• Do you think patients feel well supported in managing their condition?
• What challenges do you face in managing patients with CVD and/or its risk factors?
• Is there anything you can think of that might facilitate the management of CVD in your population?
• How might management of CVD be improved in your population?

Mobile phone use:

• What experiences have you had using mobile phones in a health care setting? (Probe: contacting patients or other health care professionals, looking up clinical information, reminders, calendar, alarm)
• Have you ever given/received health care information on your mobile phone? If so, in what way? (Probe: given advice to patients; received information as advertising e.g. prescribing certain drugs)

Potential role of mobile phones in CVD management:

• What particular benefits are there of using mobile phones in managing CVD? (Probe: effects on drug adherence, improving accessibility to health care information, better appointment attendance, communication)
• What particular concerns do you have of using mobile phones to manage CVD? (Probe: usability, understanding, cost)
• Do you think patients would like to use mobile phones in managing their condition?
• More specifically, what do you think the advantages/disadvantages are of using mobile phones in:
  - primary prevention of CVD, i.e. managing CVD risk factors?
  - secondary prevention of CVD, i.e. preventing further acute CVD episodes? (Probe: sending in clinical data measured at home, e.g. blood pressure or blood glucose; providing healthy lifestyle reminders, contact with patients, inability to measure outcomes yourself, etc.)
• How do you think such a system would affect your job as an ASHA?
• Any further comments/ideas regarding mobile phone use in CVD management
Thank you so much for your time, your participation in this research is greatly appreciated.
Interview topic guide for Physicians

Introduction:
As you know, we are currently looking into ways in which mobile phones can be used to help support those living with cardiovascular disease (CVD) and/or its risk factors in order to better manage their condition. We would like to explore your views on the current management of CVD and the potential for the use of mobile phones in this aspect. If at any point you do not wish to answer any of the questions, you may say so and I will move on to the next question. You are free to terminate the interview at any point, in which case the data you provide will be erased. Do you have any questions before we begin?

Experience of current CVD management:
• What is your current role in managing patients with CVD and/or CVD risk factors?
• What kind of things do you make appointments with patients for?
• How do you feel about the amount of contact you have with your patient?
• What challenges do you face in managing patients with CVD and/or its risk factors?
• Is there anything you can think of that might facilitate management of CVD in this population?
• In what ways can the management of CVD be improved in your population?

Mobile phone use:
• What experiences have you had using mobile phones in a health care setting? (Probe: contacting patients or other health care professionals, looking up clinical information, reminders, calendar, alarm)
• Have you ever given/received health care information on your mobile phone? If so, in what way? (Probe: given advice to patients; received information as advertising e.g. prescribing certain drugs)

Potential role of mobile phones in CVD management:
• What particular benefits are there of using mobile phones in managing CVD? (Probe: effects on drug adherence, improving accessibility to health care information, better appointment attendance, communication)
• What particular concerns do you have of using mobile phones to manage CVD? (Probe: usability, understanding, cost)
• Do you think patients would like to use mobile phones in managing their condition?
• More specifically, what do you think the advantages/disadvantages are of using mobile phones in:
  o primary prevention of CVD, i.e. managing CVD risk factors?
  o secondary prevention of CVD, i.e. preventing further acute CVD episodes? (Probe: sending in clinical data measured at home, e.g. blood pressure or blood glucose; providing healthy lifestyle reminders, contact with patients, inability to measure outcomes yourself, etc.)
• How do you think such a system would affect your job as a doctor?
• Any further comments/ideas regarding mobile phone use in CVD management

Thank you so much for your time, your participation in this research is greatly appreciated.
Interview topic guide for Patients

Introduction:
As you know, we are currently looking into ways in which mobile phones can be used to help support those living with cardiovascular disease (CVD) and/or its risk factors in order to better manage their condition. We would like to find out how you currently experience your condition and how you think mobile phones can be used in managing your condition in the future. If at any point you do not wish to answer any of the questions, you may say so and I will move on to the next question. You are free to terminate the interview at any point, in which case the data you provide will be erased. Do you have any questions before we begin?

Experience of current CVD management:
- How has this condition impacted on your life?
- How do you currently manage your condition? (Probe: do you remember to take medication, appointments, maintain healthy behaviours, do you know what symptoms you should be aware of)
- What challenges do you face in managing your condition?
- If you have questions relating to your condition, how do you usually go about answering them?
- What is your experience of the current care provided to you?
- When would you normally contact your doctor or ASHA?
- Is there anything you can think of that might facilitate the management of your condition?

Mobile phone use:
- Do you personally own a mobile phone, or do you share the use of a mobile phone with others?
- How confident are you in using a mobile phone?
- What things do you use a mobile phone for in daily life? (Probe: texts, calls, internet, alarms, calendars, pictures, social media; are they aware of all the functions of their phone)
- Have you had any experiences in the past in using your mobile phone for managing your health? (Probe: appointment reminders, calls from doctors, health apps, medication reminders)

Potential role of mobile phones in CVD management:
- How do you feel about using a mobile phone to manage your condition? (Probe: in terms of travel, cost, time saved; give examples of things that you could do using a mobile phone instead of in person)
- What kind of things would you like to receive information about concerning your condition? (Probe: health behaviours, appointments, medication)
- How would you like to receive such information using your mobile phone?
- How do you think a system, such as reminders about appointments, lifestyle change, and taking medications might benefit you in managing your condition?
- What would benefits would you expect from such a system? (Probe: in terms of care given, how they manage their condition, how they feel, outcomes)
• What difficulties might you anticipate in using such a system? (Probe: cost, understanding, confidentiality)

• Can you think of any other ways mobile phones can be used to help you manage your condition?

Thank you so much for your time, your participation in this research is greatly appreciated.
Appendix 4: Codebook

N.B. The codebook is a list of codes generated during data interpretation and was used to visualise the point at which no more codes were being generated in order to determine data saturation. It is not a representation of coding density as codes may have been represented more than once in a single interview. Coding density was analysed using NVivo.

1. Experiences and challenges of current CVD management

<table>
<thead>
<tr>
<th>Code</th>
<th>When to use</th>
<th>Example</th>
<th>Interviews where code is used (interview number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referral</td>
<td>When participant mentions referring patients to higher/alternative services</td>
<td>&quot;If the patient is showing a sudden symptom, I will refer them to a cardiologist&quot;</td>
<td>ASHA 1,2,3 Physician 2,4,5 (1,4,5,7,10,14)</td>
</tr>
<tr>
<td>Home visits</td>
<td>When participant mentions visiting patients’ homes</td>
<td>“I visit patients at home”</td>
<td>ASHA 1,2,3,4,5 (1,4,7,10,13)</td>
</tr>
<tr>
<td>Signs/Symptoms</td>
<td>When participant mentions looking for signs and asking about symptoms of disease</td>
<td>“And then I see if there are any signs which need to be seen by a doctor”</td>
<td>ASHA 1 Physician 4,5 (1,11,14)</td>
</tr>
<tr>
<td>Checking compliance</td>
<td>When participant discusses the need to make sure patient is taking medication properly</td>
<td>“Then I see whether they are taking their medications on time, taking regularly or not”</td>
<td>ASHA 1,3,4 Physician 3 (1,7,8,10)</td>
</tr>
<tr>
<td>Clinical measurements</td>
<td>When participant mentions their role in taking clinical measurements, e.g. blood pressure</td>
<td>“And to repeat the examination, to analyse their BP and see whether it is an acceptable level”</td>
<td>ASHA 1,3 Physician 2,3,4 (1,5,7,8,11)</td>
</tr>
<tr>
<td>Early diagnosis and screening</td>
<td>When participant mentions role of early diagnosis and disease screening</td>
<td>“We have detected many of people who have just started with disease”</td>
<td>ASHA 4 Physician 2,4,5 (5,10,11,14)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>When participant talks patients visiting the health centre for a follow up</td>
<td>“So if you once get a patient with a high BP, we will start the medicine, and then ask them to come back for a follow-up”</td>
<td>ASHA 2,3,4 Physician 2,3,4,5 Patient 1,2,4,5 (3-8,10-12,14,15)</td>
</tr>
<tr>
<td>Medication</td>
<td>When participant discusses giving/receiving medication as part of practice</td>
<td>“And we treat them using both health advice and medication”</td>
<td>ASHA 1,2 Physician 1,2,3,4,5 Patient 1,2,3,4,5 (1-6,8,9,11,12,14,15)</td>
</tr>
<tr>
<td>Medication problems</td>
<td>When participant discusses problems with taking medication</td>
<td>“So that is one issue, having to take medicines regularly”</td>
<td>Patient 3,4,5 (9,12,15)</td>
</tr>
<tr>
<td>Patient support</td>
<td>When participant talks about generally supporting patients</td>
<td>“We are giving a lot of support to them, in taking their medications and coming for regular check-ups”</td>
<td>ASHA 1,2,3,4,5 Physician 1,2,5 Patient 5 (1,2,4,5,7,10,13,15)</td>
</tr>
<tr>
<td>Health advice</td>
<td>When participant mentions role of health workers in giving patient general health advice</td>
<td>“We give them advice from the doctor about medicine, exercise, food controlling, we explain to them why this is needed”</td>
<td>ASHA 1,2,3,4,5 Physician 1,2,3,4 Patient 3 (1,2,4,5,7,9,10,11,13)</td>
</tr>
<tr>
<td>Consulting to clarify doubts</td>
<td>When participants mention that patients consult the doctor when they would like to clarify doubts</td>
<td>“I go to the doctor with my doubts and I consult the doctor”</td>
<td>Patient 1,2,3,4,5 (3,6,9,12,15)</td>
</tr>
<tr>
<td>Family influence</td>
<td>When participants mention the influence of the family on healthcare</td>
<td>“Sometimes we give the patient advice, and the other family members are listening, so the family members help them to follow the advice”</td>
<td>ASHA 2,3 Patient 4,5</td>
</tr>
<tr>
<td>Fear influence</td>
<td>When participant mentions the influence of fear on healthcare</td>
<td>“The last stage is when patients see the doctor, after they have had an operation, or angiogram, in the hospital, when they feel frightened”</td>
<td>ASHA 2 Physician 2 Patient 3</td>
</tr>
<tr>
<td>Diet</td>
<td>When participant discusses the need to modify/control diet</td>
<td>“Beef, fish, chicken, food! They eat lots of this. And lots of coconut oil! Not enough vegetables and too much food...Snacks, lots of snacks”</td>
<td>ASHA 1,2,3,4,5 Physician 1,3,4 Patient 1,3,4,5</td>
</tr>
<tr>
<td>Exercise</td>
<td>When participant discusses need to improve exercise</td>
<td>“And less exercise, they don’t do enough exercise. Now they just sit and watch TV, eating food”</td>
<td>ASHA 1,2,5 Physician 1,3,4 Patient 1,2,3,4,5</td>
</tr>
<tr>
<td>Alcohol</td>
<td>When participant mentions alcohol problems in population</td>
<td>“Drinking, lots of the people of Kerala are drinking”</td>
<td>ASHA 2,3,4,5 Physician 1</td>
</tr>
<tr>
<td>Smoking</td>
<td>When participant mentions smoking problems in population</td>
<td>“The most risk factor in our community is lifestyle problems, lifestyle issues like smoking”</td>
<td>ASHA 3,4,5 Physician 1,4 Patient 2</td>
</tr>
<tr>
<td>Difficulties changing lifestyle</td>
<td>When participant talks about the difficulties patients experience in making lifestyle changes</td>
<td>Some patients are alcoholic and they find it difficult to give up the alcohol...these are the hardest lifestyles to change”</td>
<td>ASHA 2,3,4,5 Physician 2,4 Patient 2</td>
</tr>
<tr>
<td>Adequate patient contact</td>
<td>When participant says there is enough patient contact</td>
<td>“I feel it's adequate time, I spend around half an hour with the patient”</td>
<td>ASHA 1,2,3,4,5 Physician 1,4,5</td>
</tr>
<tr>
<td>Inadequate patient contact</td>
<td>When participant says there is not enough patient contact</td>
<td>“We don’t get enough time to actually see a patient properly. We just rush through most of the patients”</td>
<td>Physician 2,5</td>
</tr>
<tr>
<td>Money</td>
<td>When participant mentions money/expenses affecting healthcare delivery</td>
<td>“Some people have a mind-set, like if we spend money we get better treatment”</td>
<td>ASHA 1,2,4,5 Physician 2,5 Patient 1</td>
</tr>
<tr>
<td>Investigations</td>
<td>When participants mentions any tests/investigations</td>
<td>“Maybe they need scanning, x-ray, ECG”</td>
<td>ASHA 2 Physician 2,4</td>
</tr>
<tr>
<td>Lack of resources</td>
<td>When participants mention a lack of resources affecting healthcare delivery</td>
<td>“We don’t have a lab. So even the basic things we have to order outside.”</td>
<td>Physician 2,4,5</td>
</tr>
<tr>
<td>Health inequalities</td>
<td>When participant mentions health inequalities in this population</td>
<td>“Not all the poor people of course can afford to buy”</td>
<td>ASHA 1</td>
</tr>
<tr>
<td>Government</td>
<td>When participant discusses the role of the government in health and Kerala’s health care system</td>
<td>“So they are having most of the medications prescribed by the government”</td>
<td>ASHA 1 Physician 2,3,5</td>
</tr>
<tr>
<td>Patient interference</td>
<td>When participant mentions patient interfering with</td>
<td>“But some of them, they’re buying medicines and causing a</td>
<td>ASHA 1 Physician 2</td>
</tr>
<tr>
<td>Improving patient awareness/education</td>
<td>When participant discusses the need to improve the awareness and education of patients</td>
<td>“People need to be more informed”</td>
<td>ASHA 1,2,3,4,5, Patient 3,4 (1,2,4,7,12,13,14)</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>Reduce risk factors</td>
<td>When participant mentions the need to reduce risk factor prevalence</td>
<td>“Management is mainly, first it is the risk factors...if the risk factors are reduced, patients with CVD will be less”</td>
<td>ASHA 1,3,4,5, Physician 1,2,3,4,5 (1,2,5,7,8,10,11,14)</td>
</tr>
<tr>
<td>Physicians are busy</td>
<td>When participant mentions that doctors are busy</td>
<td>“Doctors may be so busy, so busy that we can’t encourage all patients to have contact with them”</td>
<td>Physician 1,3,4,5 (2,8,11,15)</td>
</tr>
<tr>
<td>ASHA/physician power</td>
<td>When participant mentions the power that health workers have over patients</td>
<td>“But if an ASHA worker or whoever says it’s necessary to come in to hospital, then they come in”</td>
<td>ASHA 1, Physician 2 (1,5)</td>
</tr>
<tr>
<td>Waiting time</td>
<td>When participant mentions waiting time at health facilities</td>
<td>“There is always a long line here and at the hospital”</td>
<td>ASHA 1, Physician 5 (1,14)</td>
</tr>
<tr>
<td>Population demographics</td>
<td>When participant mentions demographics specific to Kerala</td>
<td>“All are literate here, there’s 100% literacy in Kerala”</td>
<td>ASHA 1,4, Physician 1,3,5 (1,2,8,10,14)</td>
</tr>
<tr>
<td>Implementing primary prevention</td>
<td>When participant mentions primary prevention measures or preventing disease development</td>
<td>“We actually give them advice to prevent...to advise them not to go to cardiovascular diseases”</td>
<td>ASHA 2,3,4,5, Physician 1,2,3 (2,4,7,8,10,13)</td>
</tr>
<tr>
<td>Patients prefer secondary prevention</td>
<td>When participant discusses patients preferring secondary prevention/not being bothered about primary prevention</td>
<td>“More for secondary prevention. Because people are not bothered about primary prevention”</td>
<td>ASHA 2,3,5, Physician 2,3,4,5 (4,5,7,8,11,13,14)</td>
</tr>
</tbody>
</table>

2. Current mobile phone use

<table>
<thead>
<tr>
<th>Code</th>
<th>When to use</th>
<th>Example</th>
<th>Interviews where code</th>
</tr>
</thead>
</table>


3. Expectations and barriers to mobile phone use in CVD management

<table>
<thead>
<tr>
<th>Code</th>
<th>When to use</th>
<th>Example</th>
<th>Interviews where code is used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Communication | When participant says they use their phone for general communication | “So you can keep regular contact with the patients” | ASHA 1,2,3,4,5, Physician 1,4,5, Patient 2,4 (1,2,4,6,7,10-14) |
| Calls preferred | When participant states that phone calls are the preferred method of communication | “They call, no messages” | ASHA 1,2,3, Physician 1,2,4,5 (1-7,9,12,15) |
| Texts not preferred | When participant explicitly states that texts are not the preferred method of communication | “Text message is limited information, nothing more nothing less” | ASHA 1, Physician 1,2,3,4,5 (1-3,5,12,15) |
| Call/text no preference | When the participant states no preference between calling or texting | “Both, either message or phone. I do not mind” | ASHA 2, Physician 2 (4,5) |
| Phones ubiquitous | When participant states everyone has/uses a mobile phone | “Because most of the patients, young or old, they have a mobile” | ASHA 1,2,3,5, Physician 1,4,5 (1,2,4,7,11,13,14) |
| Internet use | When participant mentions using the internet on their phone | “Nowadays, internet are also available on phone, so we can easily access those information from the net too” | ASHA 4, Physician 1,3, Patient 3 (2,9,10) |
| Advertising | When participant says they have received advertising through their mobile phone | “We have experienced also call from some private companies, to advertise drugs” | Physician 3 (8) |
| Current use: appointments | When participant mentions using their phones to make appointments | “We use it to fix a time to see the doctor, to make appointment” | ASHA 2,3,4, Physician 5 (4,7,10,13) |
| Current use: clarifying doubts | When participant uses phone to clarify doubts | “Patients can contact the ASHA workers for any doubts or problems” | ASHA 3,4,5, Physician 5, Patient 3 (7,9,10,13,14) |
| Current use: referrals | When participant mentions use of phones to refer patients | “We use [phones] to refer patients diagnosed with CVD to cardiologists or physicians” | Physician 2,4,5 (5,11,14) |
| Phones improve health accessibility | When participant mentions that phones improve accessibility to healthcare services | “We can be using mobile phones to...give information about the different services available” | ASHA 1,2,4,5  
Physician 1,2,3,5  
Patient 2,4  
(1,2,4,6,8,10,12,14) |
|---|---|---|---|
| Phones improve health knowledge | When participant mentions that phones will improve their knowledge about health/disease | “We can be using mobile phones to help give information about the disease” | ASHA 4,5  
Physician 1,3,4  
Patient 2  
(2,6,8,10,11,13) |
| Phones improving communication | When participant states that phones will generally improve communication | “We can get good control of their symptoms, and better communication” | ASHA 1,2,3,4,5  
Physician 1,4,5  
Patient 4  
(1,2,4,7,10,14) |
| Phones for providing reminders | When participant discusses benefits of providing reminders of medication, appointments, lifestyle change | “We can give them messages for the advice and to remember” | ASHA 1,2,3,5  
Physician 1,2,3,4,5  
Patient 1,3,4,5  
(1,5,7,9,11,13) |
| Phones to make appointments | When participant says phones are useful for arranging appointments | “It would be useful to phone about appointments and medication” | ASHA 2,3,4  
Physician 2,3,5  
Patient 1,4,5  
(3,5,7,8,10,12,14,15) |
| Phones to help change lifestyle | When participant states that phones may help to change poor lifestyle | “If it was available, it would be beneficial to receive information about healthy lifestyle” | ASHA 2  
Physician 1,2,3,5  
Patient 1,2,3,4  
(2,6,8,9,12,14) |
| Phones to clarify doubts | When participant mentions that phones could help patients/health workers clarify doubts about disease | “So if there is any doubt, I can ask the doctor by telephone” | ASHA 3,4,5  
Physician 2,5  
Patient 2,3  
(5,7,9,10,13,14) |
| Phones to transmit data | When participant mentions that phones can be used to share clinical data, e.g. blood pressure readings, between patients and health workers | “We could send results through mobile phones, like the sugar levels, and the doctor can easily understand what is going on” | ASHA 3,5  
Physician 3,5  
(7,8,13,14) |
| Phones in emergencies | When participant states it would be useful to use phones in emergency situations | “In case of emergencies, if we are using phones, it would be more helpful to quickly contact the doctors” | ASHA 4,5  
Physician 2,4  
Patient 4  
(5,10-13) |
| Phones for symptom assessment | When participant mentions that phones might be useful for symptom assessment | “Patients could call and phone up with their symptoms” | ASHA 1  
Physician 4  
Patient 2  
(1,6,11) |
| Phones for reporting disease | When participant discusses the potential for phones in reporting disease | “Like, alert about some outbreak of any disease” | ASHA 5  
Physician 1  
(2,13) |
| Potential for text messaging | When participant discusses potential for using text messages | “Like if there was a text in mobiles in which you could send Malayalam messages, that would be better.” | ASHA 1,2  
Physician 2  
(1,4,5) |
| Phone usability | When participant mentions the usability of phones as a barrier | “First you need to know how to actually use the device before it can be useful. That’s one of the main drawbacks” | ASHA 3,4  
Physician 1,2,4  
Patient 3,4,5  |
<table>
<thead>
<tr>
<th>Phone acceptability</th>
<th>When participant mentions the acceptability of phones as a barrier</th>
<th>“Perhaps also the acceptance, will others and the doctor like it, I am not sure”</th>
<th>Physician 4 Patient 2 (6,11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider age</td>
<td>When participant mentions the need to consider age when thinking about usability of phones</td>
<td>“The patients are not aware of the function of mobile phones, especially those above 50 or 60, those who are elderly, so they do not use it”</td>
<td>ASHA 4 Physician 1,2,4 Patient 5 (2,5,10,11,15)</td>
</tr>
<tr>
<td>Perceived patient preferences</td>
<td>When participant says that patients would prefer to use mobile phones in healthcare</td>
<td>“Yes...they can call the ASHA, the doctor, it is easy for them to contact the healthcare”</td>
<td>ASHA 1,2,3,4 Physician 1,3,4,5 (1,2,4,7,8,10,11,14)</td>
</tr>
<tr>
<td>Phones expensive</td>
<td>When participant mentions the expense of using their phone</td>
<td>“If I call the patient, I am using my own money, I don’t get any reimbursement”</td>
<td>ASHA 1,2 (1,4)</td>
</tr>
<tr>
<td>Phones not expensive</td>
<td>When participant says phone use is not expensive</td>
<td>“Mobile phone cost is not very costly compared to other things”</td>
<td>Patient 3,4,5 (9,12,13)</td>
</tr>
<tr>
<td>Phones not a disturbance</td>
<td>When participant states that phones are not a disturbance to him/her</td>
<td>“It’s not a disturbance, it doesn’t trouble me”</td>
<td>ASHA 1 (1)</td>
</tr>
<tr>
<td>Phones a disturbance</td>
<td>When participant says that phone use is a disturbance</td>
<td>“After a while it’s a disturbance, someone calling, we can’t continue with our work”</td>
<td>Physician 1,3,5 (2,8,14)</td>
</tr>
<tr>
<td>Positive effect on job</td>
<td>When participant states that mobile phone use would have a positive effect on their job</td>
<td>“Our work efficiency can be improved”</td>
<td>ASHA 2,3,4,5 (4,7,10,13)</td>
</tr>
<tr>
<td>Negative effect on job</td>
<td>When participant states that mobile phone use would have a negative effect on their job</td>
<td>“but for the doctors I think that maybe their job will be affected”</td>
<td>Physician 1,4,5 (2,11,14)</td>
</tr>
<tr>
<td>Phones will benefit patients</td>
<td>When participant says that mobile phone use will benefit patient’s health</td>
<td>“Actually it will be more effective for the patients, for the community”</td>
<td>Physician 1,3,5 (2,8,14)</td>
</tr>
<tr>
<td>Phones save money</td>
<td>When participant mentions phones saving money</td>
<td>“So the time, the cost, the travelling, all that is saved with the mobile phone”</td>
<td>Patient 2,3 (6,9)</td>
</tr>
<tr>
<td>Phones save time</td>
<td>When participant mentions phones saving time</td>
<td>“So the time, the cost, the travelling, all that is saved with the mobile phone”</td>
<td>Physician 2,5 Patient 2,3,5 (6,9,11,14)</td>
</tr>
<tr>
<td>Phones save travel</td>
<td>When participant mentions phones saving travel</td>
<td>“So the time, the cost, the travelling, all that is saved with the mobile phone”</td>
<td>Physician 1,2,5 Patient 1,2,3 (2,3,5,6,9,14)</td>
</tr>
<tr>
<td>Direct patient contact preferred</td>
<td>When participant says that they would rather have direct contact than use mobile phones</td>
<td>“We can clear their doubts then and there, if we have that direct contact with them. Through phones, it’s only a one way street”</td>
<td>Physician 1,2,3,4 Patient 1,2,4 (2,3,5,6,8,11,12)</td>
</tr>
<tr>
<td>Radiation fears</td>
<td>When participant mentions harmful effects from radiation as a barrier</td>
<td>“we fear the mobiles make the heart weak, make the heart problems, because of the radiation”</td>
<td>ASHA 2,3,5 Physician 1 (2,4,7,13)</td>
</tr>
</tbody>
</table>