System-level interventions to improve the availability, accessibility and quality use of essential medicines for cardiovascular disease prevention in Indonesia

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Main Collaborators:

The George Institute for Global Health
University of Brawijaya
Malang District Health Authority
University of Manchester

Abstract

The overall goal of this research is to improve the availability, access and quality use of essential preventive cardiovascular disease (CVD) medicines in rural Indonesia. The target population is adult residents at high risk of CVD events in rural communities near Malang, East Java. The project builds on an existing community-based intervention, with its associated platform and data, and will focus on developing and pilot testing a multi-component intervention to address known constraints in the supply and utilization of CVD medicines. The intervention will comprise a voucher system to provide patients with a period of subsidized prescribed CVD medicines; a digital health solution to assist health clinics in procurement and inventory control of CVD medicines; training, support and incentives to health workers to deliver appropriate CVD care; and a community awareness program on CVD risk and its management. Mixed quantitative and qualitative methods will be used to co-produce this system-level intervention with policy makers, administrators, healthcare providers and community members. A subsequent pilot study will evaluate feasibility and provide preliminary evidence on effectiveness, acceptability, barriers, facilitators and costs. These data will be used to refine the intervention and develop a detailed proposal for large-scale implementation with rigorous evaluation. This proposal involves an established multinational collaboration with a track record of high quality applied health systems research and the required local expertise and networks to ensure success.

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Reviewer Comments

While all review panel members were interested by your program and look forward to reading your full proposal, there is a desire to understand in more detail what type of interventions your organization anticipates could be piloted (objective 4).

We have now provided considerable detail relating to system level interventions that will be developed in parallel, and then pilot-tested in combination.

In summary, these interventions are:

1. A voucher system to provide patients with a period of subsidized prescribed CVD medicines.
2. A digital health solution to assist health clinics in procurement and inventory control of CVD medicines.
3. Training, support and incentives to health workers to deliver appropriate CVD care
4. A community awareness program on CVD risk and its management.

Main Section of the proposal

(max 15 pages)

1. **Overall Goals and Objectives**

The ***overall goal*** of this research is to improve the availability, access and quality use of essential preventive cardiovascular disease (CVD) medicines in rural Indonesia. This will be achieved by developing and pilot testing a multifactorial intervention that addresses known constraints in the supply and utilization of CVD medicines in rural Indonesia. The project brings together a team of international and local experts and employs a co-production approach to intervention development. This approach will draw on both the best available evidence as well the perspectives of providers, government officials, relevant NGOs and the community to design a system-level intervention that is tailored to the local context.

Alignment with the focus of the RFP:

This proposal:

- Aims to improve care for patients with high levels of CVD risk in Indonesia, with a focus on both primary and secondary prevention using an "absolute CVD risk" lens.
- Aligns with relevant international frameworks and Indonesian government priorities, strategy and standards.
- Directly builds on an intervention that is currently being deployed in Malang, East Java.
- Utilizes cutting-edge, interdisciplinary implementation science methods to develop system-based interventions that have a high probability of being effective, taken up and sustained.
- Builds local research and implementation capacity.

This proposal builds on the applicants' SMART*health* program – a major research initiative that uses state-of-the art decision support deployed on mobile devices to assist doctors, nurses and community health workers in the provision of high quality primary health care for CVD prevention and management.[1-3] SMART*health* addresses fundamental deficiencies in workforce and community capacity to implement best practice care. The system has been implemented in several areas in India and in Malang district, East Java, Indonesia and has generated highly encouraging feasibility data (effectiveness data available March 2018). However, in the course of this work, we have identified critical systems barriers relating to essential medicines that need to be addressed to enhance impact, and allow sustainable scale-up.

In this application, we seek to address those barriers. We will:

(1) conduct a theory-informed, mixed methods analysis of system-related barriers at the policy, service provider and community levels; and

(2) partner with key stakeholders to develop and feasibility-test solutions to address these barriers.

Our approach will be co-production[4] of strategies with decision makers, to maximise the likelihood that new interventions can be incorporated into regional and national policies and practice.

Alignment with partner organisations goals:

The George Institute for Global Health is a non-profit research organization (affiliated with the University of New South Wales, Peking University Health Sciences Center, and the University of Oxford) with a mission to improve the health of millions worldwide. With offices in Australia, China, India and the UK, the Institute is devoted to finding innovative ways to manage common serious chronic diseases faced by vulnerable and disadvantaged people worldwide.

University of Brawijaya is a top 10 university and research institution in Indonesia located in Malang, East Java. The Department of Public Health within the School of Medicine actively conducts research in social medicine, health promotion and disease prevention. The department has a longstanding partnership with the regional health authorities in Malang.

Malang District Health Agency is a local government health authority that is responsible for regulating and managing the health facilities, medication distribution, health workers and health financing, and delivery of healthcare program at Malang; this agency is the local government partner for the on-going SMART*health* program.

The University of Manchester is a research-led university and member of the Russell group of leading universities in the U.K. Across the basic, clinical and public health sciences the university has distinguished itself over the years by focusing on solutions that enhance the health and wellbeing of people around the world. The team from the university is noted for its deep experience and strong commitment to health and wellbeing in Indonesia.

The ***specific key objectives*** of this research are:

1. To conduct a landscape analysis of national and local policies related to drug financing, availability, procurement and distribution; and to determine the barriers to their implementation at all health service levels.
2. To co-produce, with key end-users, “testable” system-level interventions to address critical gaps in medicine availability, distribution and use.
3. To understand financing implications of the proposed system-level interventions for best practice CVD medicine use at the population level.
4. To conduct a preliminary evaluation of the combined interventions to determine feasibility.

2. Current Assessment of Need in Target Area

The data generated to date from the SMART*health* program implementation provide a compelling argument for the need to improve CVD care in this region. The program is currently being implemented in 8 villages (4 intervention and 4 control) in the Malang district of East Java, and the summative evaluation will be completed in March 2018. The SMART*health* system has been described in detail elsewhere.[1] In brief, it comprises the following elements:

1) Community healthcare workers (Kaders), nurses and primary healthcare (PHC) doctors were trained to assess CVD risk using a clinical decision support system application on a 7-inch Android tablet device. The application allowed Kaders to collect essential health-related information from members in their community, inform the subject of their risk status, provide lifestyle advice relating to physical activity, diet and tobacco and alcohol, and refer high risk patients to the PHC doctor. In addition, the application provided decision support to doctors for medication prescription.
2) Kaders received a 5-day training induction and ongoing support from field supervisors. Each Kader was provided with a back pack sized kit, containing the tablet, an automated BP monitor, a glucometer and other management resource. Three BP readings are measured, with the average of the last two readings considered. Nurses received a 2-day induction while the Doctors received a 1-day induction and ongoing field support from a medically trained staff of the University of Brawijaya.
3) Kaders conduct household-based assessments using the tablet device. Data are asynchronously uploaded to a shared electronic medical record (OpenMRS)[5] via the Sana Mobile Dispatch Server and stored on a centralised server.
4) Three modules were developed in OpenMRS to support patient tracking: (a) a cohort creator which facilitated grouping participants (e.g. those screened by a Kader up to a point in time); (b) a patient priority module to help Kaders prioritise workload for follow-up visits and screening of new participants; and (c) an alert/reminder module to provide feedback on whether patients were achieving recommended targets.
5) The nurses and doctors access the data uploaded by the Kaders via OpenMRS and are provided with decision support recommendations for CVD risk factor management. Doctors are prompted to prescribe medications from the drug classes that are available on the essential medicine list in primary health care facilities and to enter a reason for not prescribing the medication if they considered this inappropriate.
6) Responses from the alert/reminder module (step 4) are used to create prompts in the Kaders' tablets to alert them to high risk individuals who require follow-up visits.
7) Patients receive reminders on medication adherence and follow-up visits with the doctor via an interactive voice response system.
8) A support team with five supervisors visits the Kaders and doctors on a periodic basis and provides support such as stock replenishment, re-training, co-ordinating, and solving IT issues. The quality of intervention is ensured by supervisor field visits. Doctors and Kaders are remunerated at comparable government rates for their time participating in the project. It amounts to an average of around $80 per month per Kader for 2 hours of work every day.

As a part of the SMART*health* evaluation, a baseline household survey with blood-based biomarker collection was conducted in the 8 participating villages (23,500 adults aged 40 years and above, representing a response rate of 80%) between October 2016 to

February 2017. Preliminary results are shown in Table 1, and show an alarmingly high prevalence of people with or at high risk of CVD: ~5.5% have an established CVD diagnosis, but an additional 23.6% are at high risk of a CVD event in the next 10 years. More than 50% of this population have hypertension. **The most concerning finding was that only 13% of those at high CVD risk and 9% of those with hypertension reported use of guideline-recommended medicines.**

Table 1 – Characteristics of screened population in Malang district, East Java

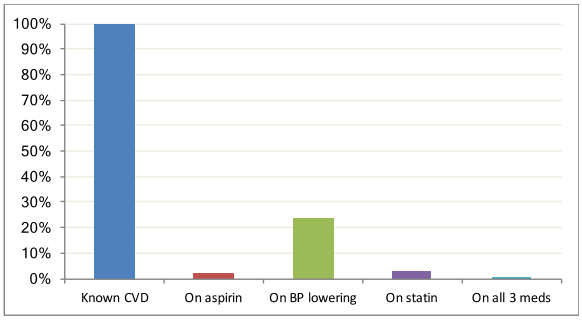
	Male (n=10,308)	**Female (n=13,314)**	**p-value**
Age (years), mean (95% CI)	54.9 (54.7-55.1)	54.7 (54.5-54.9)	0.0037
Currently smoking, % (95% CI)*	60.1 (59.1-61.0)	0.9 (0.7-1.0)	<0.0001
Currently chewing tobacco, % (95% CI)*	0.1 (0.1-0.2)	0.3 (0.2-0.4)	0.002
Established CVD, % (95% CI)*	5.4 (5.0-5.9)	5.5 (5.1-5.9)	0.706
Myocardial infarction/angina, % (95% CI)*	2.9 (2.6-3.3)	3.5 (3.2-3.8)	<0.0001
Stroke, % (95% CI)*	2.7 (2.4-3.1)	2.1 (1.9-2.4)	0.002
Peripheral vascular diseases, % (95% CI)*	0.1 (0.1-0.2)	0.2 (0.1-0.2)	0.849
Self-reported diabetes, % (95% CI)	4.5 (4.1-4.9)	6.4 (6.0-6.8)	<0.0001
All diabetes, % (95% CI)	7.5 (7.1-8.1)	11.2 (10.6-11.7)	<0.0001
SBP (mmHg), mean (95% CI)	138.1 (137.7-138.5)	141.4 (141.0-141.8)	0.0001
DBP (mmHg), mean (95% CI)	88.0 (87.7-88.2)	88.1 (87.9-88.4)	0.2303
Hypertension, % (95% CI)†	50.1 (49.2-51.1)	55.2 (54.4-56.1)	
10-year adjusted CVD risk, % (95% CI)			
I. < 10% risk	67.4 (66.5-68.3)	64.6 (63.8-65.4)	<0.0001
II. 10-20% risk	6.4 (6.0-6.9)	4.0 (3.6-4.3)	
III. 20-30% risk	1.4 (1.2-1.7)	0.6 (0.5-0.8)	
IV. 30-40% risk	0.14 (0.08-0.24)	No observation	
V. >40% risk	0.03 (0.01-0.1)	0.02 (0.00-0.06)	
VI. Established CVD	3.3 (3.0-3.7)	3.6 (3.3-3.9)	
VII. BP ≥160/100mmHg	19.1 (18.3-19.8)	25.2 (24.4-25.9)	
10-year adjusted cardiovascular risk groups, % (95% CI)			
Low risk (I+II)	73.9 (73.0-74.7)	68.6 (67.8-69.4)	<0.0001
Intermediate risk (III)	1.4 (1.2-1.7)	0.6 (0.5-0.8)	
High risk (IV+V+VI+VII)	24.7 (23.7-25.5)	30.7 (30.0-31.5)	
BP lowering treatment overall, % (95% CI)*	6.2 (5.6-6.9)	10.4 (9.8-11.1)	<0.0001

BP, blood pressure; CI, confidence interval; CVD, cardiovascular disease; DBP, diastolic blood pressure; SBP, systolic blood pressure.
*self-reported
†Hypertension defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg

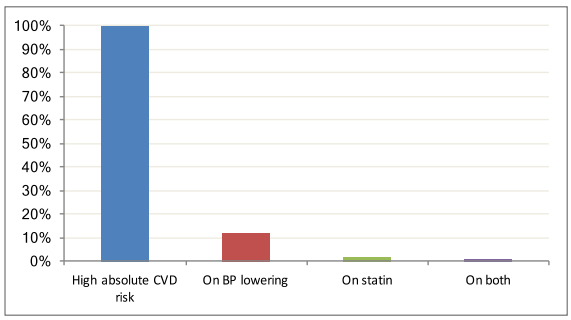
The Cascade of Care[6,7] figures below help further illustrate "what is" in the Malang district population, versus "what should be" in ideal circumstances. It clearly demonstrates that a very small minority of individuals is receiving guideline recommended care.

Figure 1 – Cascades of Care for patients with A) Known CVD; B) High absolute CVD risk; C) Hypertension; and D) Diabetes

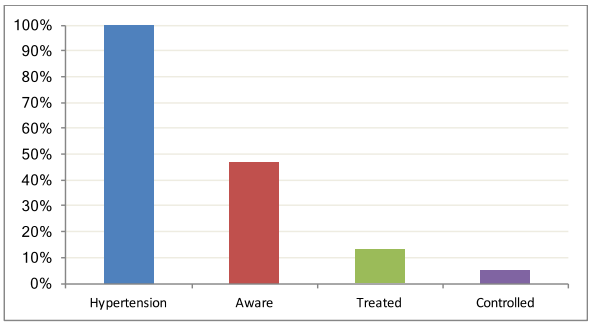
A. Known CVD



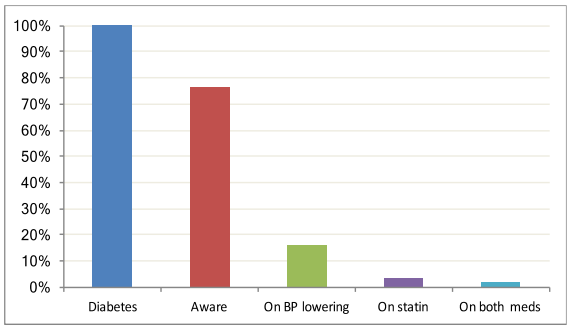
B. High absolute CVD risk



C. Hypertension



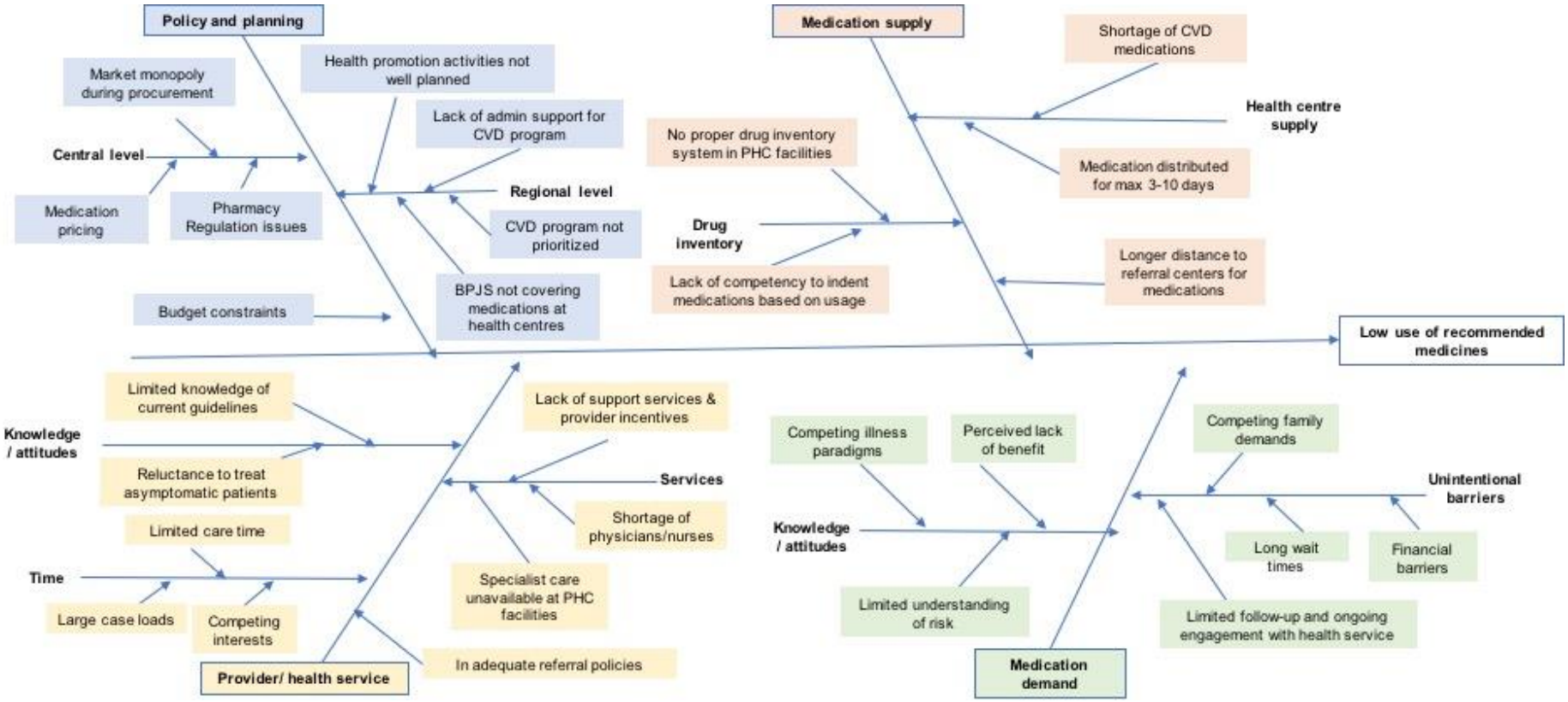
D. Diabetes



To better understand the drivers for these large evidence-practice gaps we conducted a health system appraisal as part of SMART*health* implementation. Multiple factors affecting drug access were identified, ranging from low community and health worker awareness of CVD and its risk factors through to upstream barriers in procurement and availability of essential drugs in the primary health services (*Pusat Kesehatan Masyarakat* or *Puskesmas*). These barriers are illustrated in the Ishikawa causal diagram (Figure 2).

In this proposal, we will focus on selected system barriers in each of the 4 broad areas of need identified above - policy and planning; medication supply; provider / health service; and medication demand.

Figure 2 – Ishikawa causal diagram on system barriers to effective availability and use of essential preventive CVD medications



3. Target Audience

The primary audiences include: (1) central, province and district level policy makers who influence the public distribution of drugs; (2) the national health insurance agency (*BPJS Kesehatan*); (3) healthcare providers involved in dispensing medications; and (4) community members who are the primary users of the system.

Through the SMART*health* program we have demonstrated our ability to recruit community members, healthcare providers (all levels) and district level policy makers. Through our partnership with Malang District Health Authority, we are confident of our ability to engage with relevant policy makers at the provincial and central level. For example, we are in continuous conversation on broader issues of health financing with the national health insurance agency, *BPJS – Kesehatan*; we have also shared a platform in promoting action to tackle non-communicable diseases with the Director General of Pharmacy and Medical Equipment.

The project outcomes will provide policy-relevant recommendations for the Directorate General of Pharmacy and Medical Equipment (*Direktur Jenderal Kefarmasian dan Alat Kesehatan*), and the Ministry of Health (*Kementrian Kesehatan*) who are responsible for formulating and implementing national policy, as well as providing technical assistance and supervision on medicine production and distribution. It is expected that the project outcomes will provide national policy guidelines and national strategies for the directorate to improve the cardiovascular medicine distribution policy in the country. At the provincial level, the outcomes will benefit the Health Resources Management Unit (*Bidang Pengembangan Sumber Daya Kesehatan*) of East Java Health Provincial Agency (*Dinas Kesehatan Provinsi Jawa Timur*) who are responsible for formulating technical operational policy for medicine distribution and health financing within East Java province. We expect the outcomes of the project will benefit in providing technical guidance for the agency in formulating technical operational policy for proper medication distribution at the province. At the district level, it is expected the project outcomes will provide technical guidance for Malang District Health Agency in improving the effectiveness of medication distribution.

We also anticipate that the national health insurance agency (*BPJS Kesehatan*) will be particularly interested in the project outcomes as one of the challenges to implementing universal insurance in Indonesia is availability of effective medication distribution systems that will ensure *BPJS* patients get the required medicine they need. We note the open line of communication we have with *BPJS Kesehatan*.

Healthcare providers involved in dispensing medicine (i.e. hospital [*rumah sakit*], public health centres [*puskesmas*], and district pharmacy warehouse agency) will also benefit from the project outcomes through development of improved standard operating procedures for CVD medication distribution, particularly through improved tools and technical capacity to determining medication needs (*Rencana Kebutuhan Obat*) and assist with district health agency planning.

By taking both a top-down and bottom-up approach, the study findings have potential to benefit a broad spectrum of end users including community members, members of district parliaments, members of Malang Indonesia's Cardiovascular Specialist Organization (*Perhimpunan Dokter Spesialis Kardiovaskuler Indonesia Cabang Malang,*PERKI), members of Village Health Post for Elderly (*Posyandu Lansia*), and Village Integrated Services for NCDs (*Pos Pembinaan Terbadu (Posbindu) Penyakit Tidak Menular*). All these national, province and district institutions as well as community members have close working relationships with Faculty of Medicine, University of Brawijaya and are highly committed to supporting successful interventions for CVD prevention and management in the region and nationally.

4. Project Design and Methods

A description of the overall strategy, linked to the goal of the project, is outlined below, with methodological detail and anticipated outputs outlined in Table 2. By design, this project will fully engage the target audiences and the extent to which this occurs will be transparently described in project outputs, while maintaining confidentiality. We believe this research is unique to the setting and is a critical requirement for any future successful interventions around CVD risk management, not limited to the SMART*health* program on which the research builds. Any new tools developed through this project will be made publicly available at no cost, assuming these are not an existing integral component of our current tools which require maintenance and frequent updating with revalidation of the decision support system.

Objective 1 **- To conduct a landscape analysis of national and local policies related to drug financing, availability, procurement and distribution; and determine the barriers to their implementation at all health service levels.**

A landscape review will document the current medicines supply policies at government and facility level, as well as any evaluative evidence around the impact of these policies. In addition, we will determine from key stakeholders their perceptions as to the barriers to optimising medicines supply and the measures needed to address these constraints. The methods used to gather these data include: (1) systematic document analyses of relevant policies ranging from regulatory to insurance/financing and review of academic and grey literature; (2) surveys assessing policy awareness and implementation with key informants at all health service levels; (3) qualitative research at the primary health service level to understand actual and barriers to policy implementation.

Objective 2 **– To co-produce, with key end-users, "testable" system-level interventions to address critical gaps in medicine availability, distribution and use.**

An intervention will be developed to address barriers in each of the 4 broad areas identified through the initial SMARThealth systems assessment (Figure 2). These strategies, rolled into a single multifaceted system intervention, will be generated and refined through co-production:

1. Policy and planning – lack of affordability in relation to essential CVD preventive medications. In response, we will propose and co-design a voucher scheme that provides patients with 6 months subsidized access to prescribed CVD medicines. Sensitivity analyses using existing SMARThealth data will be conducted to model voucher scheme costs and determine payment thresholds that are acceptable to policy stakeholders.

2. Medication supply – a lack of co-ordination and gaps in the supply chain will be addressed by the development and incorporation of eHealth / mHealth tools for supply management. There are many open source products available that have been tested in other LMIC settings and these will be reviewed and adapted for use in this setting taking a user-centred design approach.

3. Provider/health service – provider motivation and capability to screen for and treat CVD risk will be addressed through a training program for Kaders, ongoing support and testing of performance-based incentives for community-level referral and prescription of essential CVD preventive medications. A discrete choice experiment of Kaders will be undertaken to assess preferences in relation to different aspects of intervention design such as level of incentive payments, training and lines of responsibility. Use of mHealth platforms for human resource management, processing of incentive payments and virtual training modules will be reviewed and tested for acceptability in this setting.

4. Medication demand – gaps in community awareness of CVD risk, prevention and treatment will be addressed through a sustainable community CVD risk awareness and medication adherence program (in addition to the voucher program outlined above). Behaviour change theories will be leveraged to understand and optimise the capabilities, opportunities and motivation to access best practice CVD care. Use of mass media, social media and other promotional activity will be finalized using co-production methodology.

The development and iterative refinement of the proposed intervention package will involve research interaction with policy makers at both provincial and district level, health administrators, health care providers at all levels, officials from national agency for health insurance (*BPJS Kesehatan*), and community members. Diverse participant samples and methods will be used to capture relevant perspectives and experiences regarding financing, procuring, distributing, and use of drugs. These will be used to identify key barriers to the potential success of the intervention package. Co-production workshops will be held to review initial survey and qualitative evidence, and through a deliberative process, will refine the detail of the strategies within the intervention that optimises acceptability to users.

***Objective 3* – To understand financing implications of proposed system-level interventions for best practice CVD medicine use at the population level.**

Initial costings of the proposed intervention package will be undertaken to enable us to understand their budgetary impact, both in initial development phase and in scaling up. In addition, the analysis of the potential distribution of costs and benefits to different organisations and individuals will be undertaken to determine design of incentives (including potential payments or transfers) that optimize implementation of

interventions. For instance, the upfront costs and financial risk to health facilities associated with an increased inventory of drugs may potentially deter involvement and therefore incentives may be required. These analyses will draw on the baseline data from the SMART*health* EXTEND study as well as interviews with program and clinic managers. Additional data on direct costs of CVD care will be collected from outpatient registers in Puskesmas and both outpatient and inpatient registers in Kepanjen hospital in Kabupaten Malang. This financial analysis will provide an initial indication of feasibility and enable us to calibrate incentives and the level of resourcing for the intervention so that its final design reflects what is affordable and can be reasonably replicated in practice.

Objective 4 – **To conduct a preliminary evaluation of the combined interventions to determine feasibility.**

A pilot study of the intervention will be undertaken to assess feasibility and quantify key parameters necessary to design a subsequent larger scale robust evaluation (see Section 5).

As indicated in Objective 2 above, the intervention will comprise 4 components:

1. A voucher system to provide patients with a period of subsidized prescribed CVD medicines
2. A digital health solution to assist health clinics in procurement and inventory control of CVD medicines
3. Training, support and incentives to health workers to deliver appropriate CVD care
4. A community awareness program on CVD risk and its management.

The 6-month pilot study will involve 2 of the current SMART*health* intervention villages, and the intervention will be implemented on top of ongoing use of SMART*health*.

Population – 2 villages, ~3000 adults aged ≥40 years (~1000 anticipated to have high CVD risk)

Outcomes – appropriate prescription and use of CVD preventive medicines; intervention fidelity, acceptability, barriers, facilitators and costs.

Data – quantitative baseline and follow-up on medication use using the SMART*health* platform; fidelity and cost data on usage of each component of the intervention utilizing the SMART*health* platform; mixed methods qualitative study to determine acceptability, barriers and facilitators.

Deliverable – study report and peer-reviewed publication and proposal for a large-scale study. In addition to assessing feasibility, this preliminary evaluation will allow refinement of the combined intervention and provide quantitative parameters that will inform the design of the trial (e.g. power estimates) and, drawing on the process evaluation, provide a detailed program logic.

In the study report, the potential impact of the proposed interventions in addressing the overall goal will be assessed using the RE-AIM framework.[8,9] This will be done utilizing all the data collected during the development of the interventions, and the preliminary evaluation:

Reach – modelled estimates of the absolute number, proportion and representativeness of individuals who would potentially be exposed to and benefit from the combined system-level intervention.
Effectiveness – modelled Cascade of Care diagrams, demonstrating predicting treatment levels and proportions achieving risk factor target levels.
Adoption – qualitative assessment of "health system readiness" to adopt the combined system-level intervention, and further required modifications to the intervention to maximise adoption prior to large-scale evaluation.
Implementation – quantitative and qualitative assessment of time, resource and other cost requirements to ensure fidelity of implementation of the combined system-level intervention.
Maintenance – qualitative assessment of the extent to which the combined system-level interventions can become institutionalized, and what changes might be required to maximize this opportunity.

Because of the nature of the work (co-design with key policy makers), the combined intervention developed can be subsequently implemented in other geographically distinct districts and further evaluated. Ultimately, however, success of this program will be determined by the emergence of a co-produced system-level intervention that our end-user partners agree to further develop, implement and evaluate at scale (see Section 5).

Table 2 – Overview of methods and anticipated outcomes for research proposed in each focus area

Objective	**Focus area**			
	Policy and planning - a voucher scheme.	*Medication supply* - development and incorporation of digital tools for supply management.	*Providers* – training, support and performance-based incentives (PBI).	*Medication demand* - sustainable community CVD risk awareness and medication adherence program.
To use a detailed understanding of policies and their implementation to develop proposed system-level interventions for best practice CVD medicine use.	**Methods:** detailed landscape review of policy and implementation documents relating to *BPJS Kesehatan*; in-depth interviews with senior policy makers and district authorities. **Anticipated outcomes:** detailed understanding of how a voucher scheme might sustainably operate in the Indonesian context.	**Methods:** policies around medication procurement and distribution; surveys of responsible administrators. **Anticipated outcomes:** detailed understanding of the feasible drugs supply management system for the Malang context.	**Methods:** policies relating to health workforce remuneration, surveys of policy makers and providers. **Anticipated outcomes:** detailed understanding of feasible training, support and PBI provision in the Malang context.	**Methods:** landscape review of relevant existing programs; analysis of sustainable funding sources for such programs within Indonesia; IDIs or FGDs with community members. **Anticipated outcomes:** detailed understanding of a feasible scope and implementation process for community-based awareness programs in the Malang context.
To co-produce "testable" system level interventions	**Methods:** In-depth interviews (IDI) and a co-production workshop to discuss, modify and refine the voucher program with key provincial and district authorities. Focus group discussions (FGD) around implementation with local	**Methods:** Review of open source systems; user-centred design workshops. **Anticipated outcomes:** design of a digital supply management system for CVD medications with implementation strategy.	**Methods:** IDI, discrete choice experiments and a co-production workshop to discuss, modify and refine training, support and PBI program with key provincial authorities and providers. **Anticipated outcomes:** Draft proposal	**Methods:** IDI and a co-production workshop to discuss, modify and refine community awareness program with district health authorities and community members. **Anticipated outcomes:**

	administrators and community members. **Anticipated outcomes:** Draft proposal for voucher scheme with implementation strategy.		for provider support and incentive scheme with implementation strategy.	Draft CVD risk awareness and medication adherence program with implementation strategy.
To understand the financial implications of the system-level intervention	**Methods:** costing, cost-sharing strategy and budget impact analyses for implementation of coverage proposal using SMART*health* population data, data on direct costs from healthcare facilities and IDI with facility managers. **Anticipated outcomes:** Final proposal for a financially feasible and "testable" voucher scheme and implementation strategy.	**Methods:** costing and budget impact analysis of deploying and maintaining a supply management system at a district level utilizing SMART*health* data to model volumes. **Anticipated outcomes:** Final proposal for a financially feasible and "testable" digital supply management system for CVD medications and implementation strategy.	**Methods:** costing and budget impact analysis of deploying and maintaining a provider support scheme utilizing SMART*health* population and provider encounter data, and data on direct costs from healthcare facilities. **Anticipated outcomes:** Final proposal for a financially feasible and "testable" provider support and incentive scheme and implementation strategy.	**Methods:** costing and budget impact analysis for program implementation. **Anticipated outcomes:** Final proposal for a financially feasible and "testable" community awareness program and implementation strategy.
To conduct a preliminary evaluation of the combined interventions	**Methods:** implementation of the combined interventions "on top" of the SMART*health* program, with preliminary feasibility and impact evaluation using the RE-AIM framework. **Anticipated outcomes:** Modified final combined intervention with detailed protocol for large-scale evaluation.			

As outlined in Table 2, a range of quantitative and qualitative methods will be employed:

- Desktop reviews - involve mapping, critically evaluating and placing together existing information or data to improve understanding of the context underlying identified health system barriers. Such information may include routinely collected government statistics, policy and procedural documents, local research including demographic and household survey data, in addition to published academic research.
- In-depth interviews[10] - in which participants are encouraged and prompted to talk in depth about the topic being investigated. In-depth interviews are often guided by a semi-structured list of interview questions, but allow freedom for both the interviewer and interviewee to explore additional points and change topic direction.
- Focus group discussions[10] - a qualitative research method for eliciting descriptive data from population subgroups. Usually comprise a group of eight to 12 persons gathered together for a group discussion on a focused topic, led by a facilitator. Focus groups may be used to elicit awareness, understanding and opinions on a particular topic, e.g. assessing the appropriateness and acceptability of an intervention to a particular population.
- Discrete choice experiments[11] – a stated preference survey providing a structured approach to eliciting robust preference data. Respondents are asked to choose between a set of hypothetical alternatives that vary on the basis of several key attributes. These choices force respondents to make 'trade-offs' between the attributes presented which enable the intervention designers to evaluate the relative importance each attribute has on respondent preference.
- Costing studies[12] – a rigorous, formal approach to the analysis of costs associated with a specific intervention, that involves definition of the intervention, characterization of units of analysis, identification of cost items, measurement of cost items, valuation of cost items, and uncertainty analyses.
- Budget impact analysis[13] – an economic assessment that estimates the financial consequences of adopting a new intervention.
- Co-production workshops[4,14] – a process fostering consultation and collaboration with key stakeholders. This approach ensures that the perspectives of those involved in the design and implementation of an intervention, from governance level through to providers and users, are valued and recognised, and places emphasis on mutual respect.
- User-centred design workshops[15,16] – bring together patients, health workers, families and communities to explore and understand their experiences with the health system. This knowledge can then be used to inform the design of accepted and effective health care interventions, including digital solutions.

5. Evaluation Design

A formal evaluation of the system-level interventions developed through this research is beyond the scope of the funding available through the RFP, and separate funding will be obtained to successfully complete this next phase.

A subsequent rigorous large-scale hybrid effectiveness / implementation study will employ a cluster randomised design to evaluate the combination system-level intervention, in the context of ongoing implementation of the SMART*health* program. Data on preventive cardiovascular medication use among high risk individuals will be collected routinely through the SMART*health* system that will allow a robust and cost-efficient evaluation of the effectiveness of the system-level intervention. The system level intervention has been designed to facilitate substantial change in preventive medication use – e.g. in absolute terms, an increase in percentage of patients at high CVD risk on antihypertensive medications of at least ~35% (from ~13% to ~50%) – and the trial will be appropriately powered to detect such an effect. In parallel, the trial will be accompanied by:

- a detailed process evaluation will provide a detailed understanding on the interplay between the intervention, other contextual features of the health system and SMART*health*.
- a cost effectiveness analysis will examine costs of the program and model changes in cardiovascular risk factors to determine incremental cost per disability adjusted life years (DALYs) averted. Given scarce community resources for programs such as SMART Health, such evidence will be critical in enabling government and other potential funders to prioritise investment.

The applicants have extensive experience of leveraging adequate funding for and executing such studies at the highest standards of academic rigour. The outputs of the research will be disseminated through traditional academic routes, but also to key end users through policy roundtables and informal engagement with government and multilateral agencies.

6. Detailed Workplan and Deliverables Schedule

This project will be completed over an 18-month timeframe with overlapping periods of completion for key activities:

- 2 months: protocol finalization and ethics committee approval
- 6 months: desktop review (can commence prior to ethics approval) and new data collection (surveys, IDI, FGDs, discrete choice experiments – after ethics approval)
- 3 months: co-production workshops and development of initial interventions / prototypes
- 3 months: costing studies, budget impact analyses and intervention refinement
- 8 months: pilot evaluation and development of final outputs

Summaries of the key activities, deliverables and deliverable schedule are presented below.

Key activities and deliverables:

Program activities	**Key deliverables**
Protocol finalisation and ethics approval for fieldwork	Full study protocol Ethics approval obtained
Focus area 1 – policy and planning	
Desktop review, IDI, FGD	Background paper*
Co-production workshop	Proposed "testable intervention"
Cost and budget impact analysis	Budget impact document and final "testable intervention"
Focus area 2 – medication supply	
Desktop review, surveys	Background paper*
User-centred design workshops	Prototype supply management tool
Cost and budget impact analysis	Budget impact document and final "testable intervention"
Focus area 3 – provider incentives	
Desktop review, surveys, IDI, discrete choice experiments	Background paper*
Co-production workshop	Proposed "testable intervention"
Cost and budget impact analysis	Budget impact document and final "testable intervention"
Focus area 4 – medication demand	
Desktop review, IDI, FGD	Background paper*
Co-production workshop	Proposed "testable intervention"
Cost and budget impact analysis	Budget impact document and final "testable intervention"
Preliminary evaluation	Peer-reviewed publication*; proposal for large scale implementation and evaluation

*expectation of peer-reviewed publication

Deliverable schedule:

Program activities	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**M13**	**M14**	**M15**	**M16**	**M17**	**M18**
Protocol finalisation and ethics approval for fieldwork																		
Focus area 1 – voucher scheme																		
Desktop review, IDIs																		
Co-production workshop and development of "testable" intervention																		
Cost study and budget impact analysis, refinement of intervention																		
Focus area 2 - medication supply																		
Desktop review, survey																		
User-centred design workshops and prototype development																		
Cost study and budget impact analysis, refinement of intervention																		
Focus area 3 - providers																		
Desktop review, survey, discrete choice experiments, IDI																		
Co-production workshop and development of "testable" intervention																		
Cost study and budget impact analysis, refinement of intervention																		
Focus area 4 - medication demand																		
Desktop review, IDI, FGD																		
Co-production workshop and development of "testable" intervention																		
Cost study and budget impact analysis, refinement of intervention																		
Preliminary evaluation, production of study report and protocol for large-scale evaluation																		

References

1. Praveen D, Patel A, McMahon S, et al. A multifaceted strategy using mobile technology to assist rural primary healthcare doctors and frontline health workers in cardiovascular disease risk management: protocol for the SMARTHealth India cluster randomised controlled trial. *Implement Sci* 2013; 8: 137.
2. Praveen D, Patel A, Raghu A, et al. SMARTHealth India: Development and Field Evaluation of a Mobile Clinical Decision Support System for Cardiovascular Diseases in Rural India. *JMIR* 2014; 2(4): e54.
3. Raghu A, Praveen D, Peiris D, et al. Engineering a mobile health tool for resource-poor settings to assess and manage cardiovascular disease risk: SMARThealth study. *BMC Med Inform Decis Mak* 2015; 15: 36.
4. Batalden M, Batalden P, Margolis P, et al. Coproduction of healthcare service. *BMJ Qual Saf* 2016; 25(7): 509-17.
5. OpenMRS. http://openmrs.org/ (Accessed: 15 October, 2017).
6. Kilmarx PH, Mutasa-Apollo T. Patching a leaky pipe: the cascade of HIV care. *Curr Opin HIV AIDS* 2013; 8(1): 59-64.
7. Nosyk B, Montaner JSG, Colley G, et al. The cascade of HIV care in British Columbia, Canada, 1996-2011: a population-based retrospective cohort study. *Lancet Infect Dis* 2014; 14(1): 40-9.
8. RE-AIM. http://re-aim.org/ (Accessed: 16 October, 2017).
9. Gaglio B, Shoup JA, Glasgow RE. The RE-AIM framework: a systematic review of use over time. *Am J Public Health* 2013; 103(6): e38-46.
10. Given LM. *The SAGE Encyclopedia of Qualitative Research Methods*. Thousand Oaks, CA: SAGE Publications Ltd, 2008.
11. Najafzadeh M, Gagne JJ, Choudhry NK, et al. Patients' preferences in anticoagulant therapy: discrete choice experiment. *Circ Cardiovasc Qual Outcomes* 2014; 7(6): 912-9.
12. Hendriks ME, Kundu P, Boers AC, et al. Step-by-step guideline for disease-specific costing studies in low- and middle-income countries: a mixed methodology. *Glob Health Action* 2014; 7: 23573.
13. Mauskopf JA, Sullivan SD, Annemans L, et al. Principles of good practice for budget impact analysis: report of the ISPOR Task Force on good research practices--budget impact analysis. *Value Health* 2007; 10(5): 336-47.
14. Farrelly R. Co-production and quality outcomes. *Br J Nurs* 2014; 23(13): 763.
15. Luna D, Quispe M, Gonzalez Z, et al. User-centered design to develop clinical applications. Literature review. *Stud Health Technol Inform* 2015; 216: 967.
16. User-centred Healthcare Design. http://www.uchd.org.uk/ (Accessed: 16 October, 2017).