Patient Preference and Adherence

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ORIGINAL RESEARCH

Post-Intervention Acceptability of a Multicomponent Intervention for Hypertension Management in Primary Care Clinics by Health Care Providers and Patients: A Qualitative Study of a Cluster RCT in Singapore

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Background: Hypertension is a major public health challenge, globally. Recently, we reported findings from cluster randomized trial in 8 primary care clinics in Singapore and showed that a multicomponent "SingHypertension" intervention comprising 1) motivational conversation by trained nurses, 2) telephone-based follow-ups, 3) standardized algorithm with single-pill combination (SPC) antihypertensive medications, and 4) subsidy on SPC antihypertensive drugs was effective on improving BP control. This paper presents the acceptability of SingHypertension multicomponent intervention among the key stakeholders.

Methods: We conducted post-implementation interviews of 38 stakeholders, including 18 patients and 20 healthcare providers (HCPs) in 4 primary care clinics randomized to the multicomponent "SingHypertension" intervention in Singapore. We used Theoretical Framework for Acceptability (TFA) framework with a focus on affective attitude, burden, ethicality, intervention coherence, opportunity cost, perceived effectiveness and self-efficacy to assess stakeholders' acceptability of the intervention.

Results: SingHypertension multicomponent intervention had high perceived effectiveness and a good fit with the value system and ethics of patients and HCPs. Physicians appreciated the guidance from standardized training in hypertension management. Although workload was increased, the nurses felt rewarded for their positive interactions with the patients during motivational conversation sessions and the telephone follow-ups. Most patients reported high self-efficacy levels, improved lifestyles, and adherence to antihypertensive medications. The limited choice of SPC medication, lack of subsidy beyond the trial duration, and shortage of nurses were significant challenges to wide-scale implementation. All HCPs and patients supported scaling up the intervention across primary care clinics.

Conclusion: SingHypertension multicomponent intervention is acceptable to the key stakeholders in Singapore. Taken together with the effectiveness of the intervention, our findings make a compelling case for scaling-up SingHypertension in primary care clinics in Singapore and possibly other countries with similar healthcare infrastructure.

Keywords: blood pressure, hypertension, cardiovascular risk, multicomponent intervention, cluster-randomized, acceptability

Introduction

Hypertension is the leading risk factor for cardiovascular disease (CVD) and accounts for 10.4 million deaths worldwide.[1] International evidence-based guidelines have underscored the importance of blood pressure (BP) control in preventing CVD. However, in real-world hypertension control remains suboptimal with only 30% individuals reaching adequate target BP

Received: 17 May 2024
Accepted: 9 July 2024
Published: 1 August 2024

levels even among high-income countries.[2] Several barriers to hypertension management exist at multiple (patients, providers, health systems) levels.[3] Multicomponent interventions addressing multiple barriers to hypertension care using task sharing approaches of healthcare provision by trained providers and non-physician healthcare workers have shown promising results in high-income countries.[4] Such interventions are likely to be cost-effective.[5] Recently, we reported findings from SingHypertension trial, a cluster randomized controlled trial (RCT) in 8 primary care clinics in Singapore over 2 years, and demonstrated that a "SingHypertension" multicomponent intervention (MCI) consisting of risk-based treatment with subsidized single-pill combination (SPC) medications, nurse-delivered motivational conversation, and telephone follow-ups of patients was effective in lowering systolic blood pressure in patients with uncontrolled hypertension compared to usual care.[6] More details can be found elsewhere.[6]

Although the SingHypertension MCI was designed to address several barriers to hypertension management and was effective and cost-effective in lowering BP,[5] it remains unclear if the multicomponent intervention was also acceptable to the stakeholders after their experience in delivering and receiving the intervention.

Although evidence on effectiveness of an intervention is paramount, it is increasingly acknowledged that "acceptability" should be considered when designing, evaluating, and implementing healthcare interventions, particularly when the interventions are complex.[7]

We aimed to explore the post-intervention acceptability of SingHypertension MCI for managing hypertension from the healthcare providers' (HCPs) and hypertensive patients' perspectives. Additionally, we sought to understand their perceptions on scalability and suggestions for wider implementation of the MCI in primary care.

This information is critical for scaling up SingHypertension MCI across all primary care clinics in Singapore.

Materials and Methods

Conceptual Framework

We used the theoretical framework of acceptability (TFA), which focuses on affective attitude, burden, ethicality, intervention coherence, opportunity cost, perceived effectiveness, and self-efficacy.[8] *Acceptability* is a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare *intervention* consider it to be appropriate based on anticipated or experienced cognitive and emotional responses. The TFA includes seven domains – affective attitude, burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness and self-efficacy.[8]

For successful implementation of interventions, Sekhon et al suggest that acceptability is necessary from both intervention deliverers and recipients.[8] If the intervention is acceptable, patients are more likely to adhere. However, if the delivery of a particular intervention is considered to have low acceptability, it may not be delivered as intended, which could impact its overall effectiveness. An effective and acceptable intervention is likely to have tremendous implications for primary care practices and can be implemented on a larger-scale. Additionally, the ability to make further modifications before wide-scale implementation holds greater promise for improving clinical practice at a health systems level.

Setting and Study Population

A network of public sector primary care polyclinics and private general practitioner clinics deliver primary healthcare for the multi-ethnic population in Singapore. The former provide care at subsidized rates to the majority of patients with chronic diseases.[9]

Singapore's public healthcare is delivered by three large healthcare clusters of polyclinics and hospitals, with SingHealth being the largest among them.

This qualitative study is embedded within a larger RCT, conducted in 8 public sector primary care polyclinics within the SingHealth group, using a cluster RCT design with 4 clinics randomized to deliver multicomponent intervention (MCI) and 4 clinics following usual care.[10]

The key features of SingHypertension MCI are a) algorithm-based hypertension management by trained physicians, b) in-clinic motivational conversation for high-risk hypertensive individuals by trained nurses, c) telephone-follow up of all hypertensive individuals by trained nurses and d) medication subsidy for single-pill combination (SPC) (losartan plus

hydrochlorothiazide) antihypertensive medication. Among the intervention clinics, 447 participants were enrolled to receive SingHypertension MCI delivered by trained HCPs during the trial and followed for two years.

Sampling and Participant Recruitment

A qualitative study using in-depth interviews was conducted between November 2020 and March 2021. The sampling frame included HCPs (physicians and nurses) and patients from the four clinics randomized to receive the SingHypertension MCI during the trial.

Participants were purposively sampled from the SingHypertension study database (patients) and the clinics (HCPs).

The inclusion criteria for HCPs were attending at least one training session and treated patients with hypertension assigned to MCI for the 2-year trial period. We sampled physicians and nurses involved in MCI delivery equally from all four clinics (5 HCPs from each of the four intervention clinics, for a total of 20). HCPs satisfying the eligibility criteria were nominated for the interviews by the clinic heads. An Email with letter of invitation was sent to the nominated HCPs. All 20 HCPs contacted agreed to participate and they were interviewed over a virtual conferencing platform (zoom).

For recruiting patient participants, a list of patients treated with MCI were identified. Patients were eligible if they had completed all the outcome evaluations, including the final 2-year follow-up. A mix of patients treated with and without SPC, both Chinese- and English-speaking participants, were purposefully included to capture diverse responses and opinions related to acceptability of the MCI. Patient participants were sampled equally from all four intervention clinics, and based on the criteria 56 patients were identified. A research coordinator invited 56 participants over telephone, of which 25 declined, 12 were not contactable 1 patient withdrawn consent before the interview. In-person interviews were conducted with the remaining 18 patients from 4 MCI clinics.

The research coordinator obtained written informed consents from all the participants who agreed to participate before the interviews and assisted in scheduling their sessions. The consent included a provision for audio recording of the interviews and using the responses anonymously.

This paper is reported according to the Standards for Reporting Qualitative Research (SRQR).[11]

This study was approved by SingHealth Centralised Institutional Review Board (CIRB: 2020–2644). The SingHypertension trial is registered at ClinicalTrials.gov. The first date of registration is 23/11/2016 and registration number NCT02972619.

Data Collection

The interview guides were developed (by THJ, CR, SY) using probes and open-ended questions that were modelled on the TFA to solicit the participants' experiences with the acceptability of MCI for hypertension care in Singapore clinics (Supplementary Files 1 and 2). Questions were tailored for participant groups (physicians, nurses and patients) based on various components and tasks related to the intervention. The guide covered participants' opinions about experience, fit, and acceptability of each component of the intervention, including training for nurses and physicians, using treatment algorithm for physicians, receiving telephone-based motivational conversation, and SPC antihypertensive medication for patients. The open-ended questions allowed us to understand patients' and healthcare providers' attitudes on the acceptability and benefits of the intervention, as well as their willingness on future participation which is important for long-term sustainability of the intervention, and ultimately its effectiveness on reducing BP and cardiovascular morbidity and mortality.

Additional topics explored suggestions for wider implementation and scalability of the SingHypertension MCI for hypertension care. Pilot testing was not conducted because all participants were familiar with the MCI. The interviewers were trained in the common study protocol, qualitative methods, principles of ethical research, and in using the probes. A translated version of the topic guide was used for Chinese-speaking participants, and Chinese interviews were conducted by native speakers (ZA).

The in-depth interviews of healthcare providers were conducted over a video conferencing platform, ensuring a private space for the interview, by an experienced qualitative researcher (CR), after written informed consent. Patient interviews were conducted in the clinics at a pre-scheduled appointment, in English or Chinese language. The interviewers had no direct relationship with the participants.

The participants completed a demographic questionnaire and provided written informed consent prior to the interviews that lasted between 25 and 55 minutes. All interviews were audio-recorded following consent, and transcribed verbatim. Interviews conducted in Chinese were transcribed verbatim and back translated to English by bilingual research team members and checked for accuracy. The video recordings were not linked to the transcripts and personal identifiers (name, age) were removed.

Data Analysis

Data was de-identified and analyzed using a combination of deductive and inductive approaches. A code list was developed by THJ, NCT and SW based on the objectives of the study.

Three team members (CR, AA, CC) independently reviewed the transcripts in detail, and the finalised transcripts were uploaded in NVivo version 11 software. The respective study interview guide themes were used for coding using inductive and thematic approach. Sections of text were assigned to the codes.

Coded verbatims were extracted through the analysis software by the research team members (CR, AA, CC), and checked by the site principal investigator (THJ, TNC). The code summaries were then interpreted thematically under the broader themes using framework analysis and grouped into the following TFA domains: 1) Affective attitudes: How healthcare providers and hypertensive individuals feel about SingHypertension intervention, 2) Burden: Perceived amount of effort towards intervention implementation, 3) Ethicality: How MCI for hypertension management has a good fit with the healthcare system and individual's value 4) Intervention coherence: Understanding of intervention by hypertensive individuals and healthcare providers 5) Opportunity costs: Benefits, profits, or values that healthcare providers and hypertensive individuals must give up to engage in the intervention, 6) Perceived effectiveness: How the MCI is perceived as likely to be effective, 7) Self-efficacy: Hypertensive patients' confidence to do behavioral changes and HCPs' capacity to perform interventions properly. Additional themes on stakeholders' views on scaling-up of the MCI were also identified deductively.

Team meetings were held periodically to discuss the coding categories, and codebook definitions were refined based on common understanding. Supplementary Files 3 and 4 contains the coding definitions and coding categories for the HCPs and patients, respectively. A senior qualitative researcher (CR) reviewed and verified the coding categories of other coders (AA, CC) based on codebook definitions. Any discrepancies were resolved through reclassification. To strengthen creditability and rigor to the analysis, coding categories were randomly verified by a fourth coder (RS) to ensure appropriate categorization under the TFA constructs, and simultaneously, any outstanding issues or ambiguities were resolved. Meaningful quotes were extracted to present evidence on acceptability under all seven constructs, and deviant cases were discussed. Data analysis was continued until all transcripts were coded, and no new ideas were generated. The audio-recordings and interview notes were consulted for validation purpose and consensus, when necessary. For rigour and transparency, our methodology was anchored to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines.[12]

Results

A total of 38 participants, 20 HCPs and 18 patients, who participated in the 2-year MCI, completed the qualitative interviews with a mean age of 51.9 (15.8) years and slightly higher females (n=23, 60.5%).

Among the 20 HCPs, 75% (n=15) were females, and the mean age was 40.1 (8.6) years. They included polyclinic physicians (n=11, 55%) and nurses (n=9, 45%) with mean years in service of 9.3 (4.2) years. Most (n=15, 75%) of them had attended both the initial and refresher training on the intervention programme. Table 1 summarizes their characteristics.

Of the 18 patients who participated, 56% (n=10) were men, mean age of 65 (10.1) years, 67% (n=12) of Chinese ethnicity, 33% (n=6) with comorbid diabetes mellitus, and one patient each had heart disease and stroke history. All patients had hypertension by design of the study.

We used a hybrid inductive and deductive approach to analyze participant responses for two purposes 1) retrospective acceptability of SingHypertension intervention based on the 7 constructs of TFA, and 2) feedback on the SingHypertension intervention further adaptation for wide-implementation and scalability.

Table 1 Participant Characteristics

	Total (N=38)	HCP (N=20)	Patients (N=18)
Age, mean years (SD)	51.9 (15.8)	40.05 (8.6)	65.0 (10.9)
Age distribution (years), n (%)			
30–39 years	12 (31.6)	12 (60)	0 (0)
40–49 years	7 (18.4)	5 (25)	2 (11.1)
50–59 years	6 (15.8)	2 (10)	4 (22.2)
60–69 years	6 (15.8)	1 (5)	5 (27.8)
70–79 years	7 (18.4)	0 (0)	7 (38.9)
Gender, n (%)			
Males	15 (39.5)	5 (25.0)	10 (55.6)
Females	23 (60.5)	15 (75.0)	8 (44.4)
Profession/ Role, n (%)	NA		NA
Physician	–	11 (55.0)	–
Nurse	–	9 (45.0)	–
Years in service, mean years (SD)	NA	9.32 (4.2)	NA
Years in service distribution, n (%)	NA		NA
<5 years	–	3 (15.0)	–
5–10 years	–	10 (50.0)	–
>10 years	–	7 (35.0)	–
SingHypertension training attendance, n (%)	NA		NA
Only initial training	–	4 (20.0)	–
Only refresher training	–	1 (5.0)	–
Both initial and refresher training	–	15 (75.0)	–
Ethnicity, n (%)#	NA	NA	
Chinese	–	–	12 (66.7)
Malay	–	–	3 (16.7)
Indian	–	–	2 (11.1)
Other	–	–	1 (5.6)
2 or more chronic conditions, n (%)	NA	NA	7 (38.9)
Comorbidity, n (%)	NA	NA	
Diabetes	–	–	6 (33.3)
Heart disease	–	–	1 (5.6)
Stroke	–	–	1 (5.6)
Years since hypertension diagnosed, n (%)*	NA	NA	
<10 years	–	–	6 (35.3)
10–20 years	–	–	4 (23.5)
>20 years	–	–	1 (5.9)
Do not know	–	–	6 (35.3)

Notes: #Ethnicity was not asked of the healthcare providers. *1 person with missing response.
Abbreviations: HCP, Healthcare providers; NA, Not applicable.

Retrospective Acceptability of SingHypertension Intervention Based on the Seven Constructs of the Theoretical Framework of Acceptability

Participant responses were mapped on the seven TFA constructs – affective attitude, burden, ethicality, intervention coherence, perceived effectiveness and self-efficacy. Overall, the MCI was shown to have good retrospective acceptability among the HCPs and patients. Figure 1A and B summarizes the themes identified and linked to the seven constructs of TFA.

Supplementary Tables 1a and b show the illustrative quotes under each TFA domain and study themes by the respondent type.

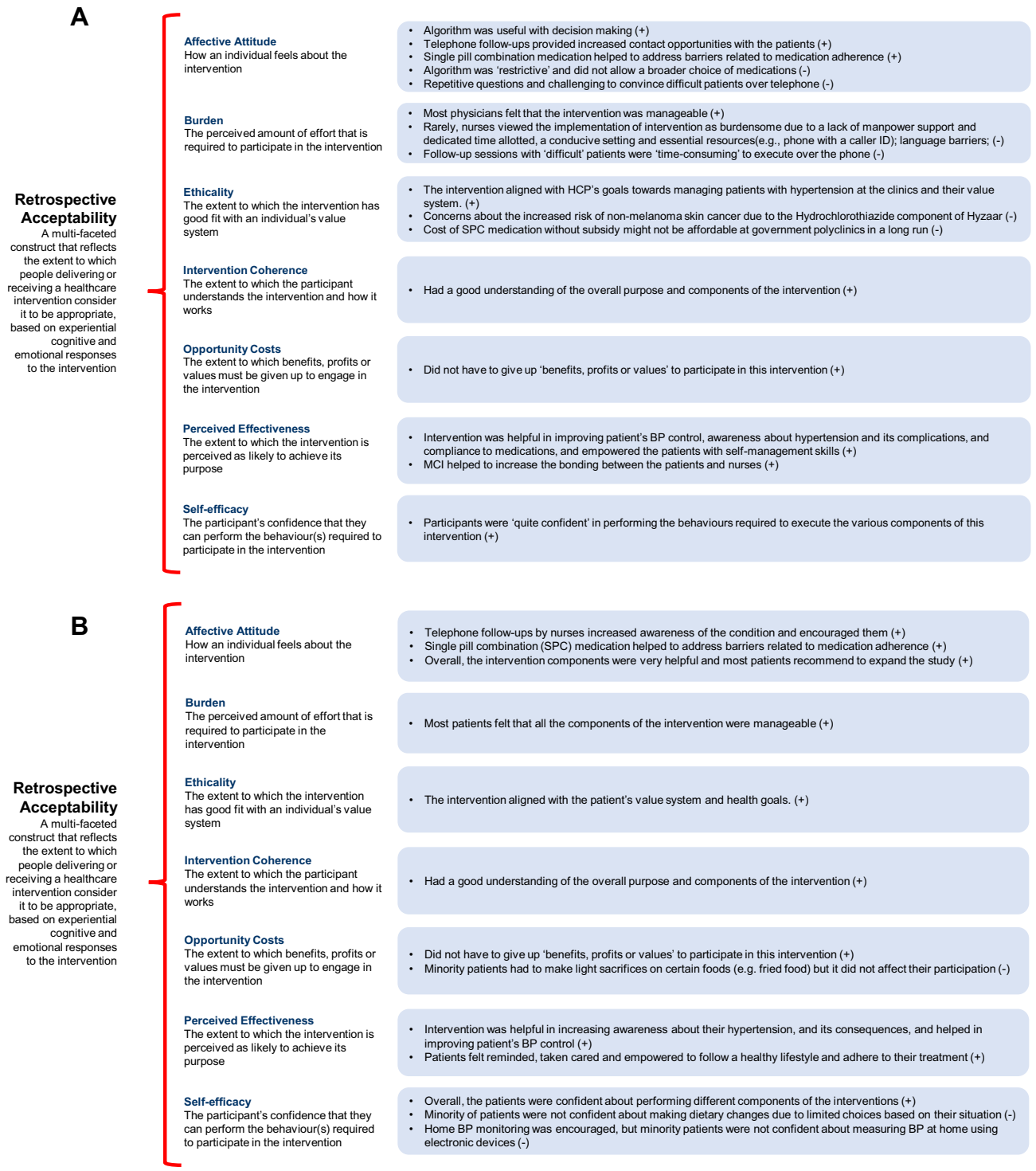

Figure 1 (**A**) Healthcare provider's perceptions on the acceptability of the multicomponent intervention (SingHypertension) using the Theoretical Framework of Acceptability. (+) indicates a positive reflection of the TFA construct; (-) indicates a negative reflection of the TFA construct. (**B**) Hypertensive patient's perceptions on the acceptability of the multicomponent intervention (SingHypertension) using the Theoretical Framework of Acceptability (+) indicates a positive reflection of the TFA construct; (-) indicates a negative reflection of the TFA construct.

Affective Attitude: How the Participant Felt About the SingHypertension Intervention?

Affective attitudes was the most prominent construct within the data and included thoughts about the different intervention components, outcomes of the intervention and patient reception.

Most participants held a positive attitude towards the intervention and described it as "good", "beneficial", "helpful", "important", "meaningful", "structured" and "targeted". They also commented that it was in line with the current standard of care, and could lead to prevention of complications, and increase patient's knowledge about the disease and self-management measures.

Regarding the intervention components, most HCPs, particularly the physicians felt that the algorithm was a "straightforward" guide, and was useful especially for junior doctors to make better treatment decisions for patients with hypertension.

> I felt that when we had that algorithm, it kind of helped the doctor and guided us to make certain decisions better. When there's an algorithm, it's easier for them 'oh, this patient just fulfils these criteria. So we just follow this algorithm and just increase this medicine, or just initiate this medicine, and what is the target and all these. So it's actually easier for them. (HCW03, Physician)

Most physicians mentioned that the multidisciplinary approach of the intervention, particularly motivational counselling by the nurses, complimented the doctors. The physicians also felt SPC was particularly helpful for patients with apprehensions about taking multiple tablets, improving their medication adherence.

> The patient was very afraid that she's taking multiple drugs, and it can cause more potential harm to her body. For them, although I told them this was actually the 3-in-1 medication, they were very happy with "I just need to take one tablet". That's their perspective. So I believe if we can subsidize more of the combination medicines, I think it would improve the control and the compliance much, much more. (HCW03, Physician)

However, some physicians expressed concerns about SPC, such as discontinuation of subsidy after the study period, limited choice of medications for them, and some patients were unwilling to change medications.

> But I am not sure whether the primary care setting is the best place for this drug, especially in (a) public polyclinic as ours. Because of the, as I've mentioned, it's subsidized currently for the study, but in the long-term, if we don't consider subsidizing, then there would be difficulties in that. (HCW10, Physician)

Most nurses felt that motivational conversation and telephone follow-up were helpful to counsel patients as doctor had short consultation time with patients, and provided an opportunity to frequently contact the patients and establish continuity of care.

> I have a lot of satisfied patient, and they are very happy to hear that the nurse is calling. So when we counsel their diet over the phone also they are able to accept and reciprocate accordingly. (HCW17, Nurse)

Few nurses reported challenges with convincing difficult patients over telephone sessions eg, those who were unhappy with repetitive questions and were resistant to desired behavioural changes. Notwithstanding these challenges, most nurses felt encouraged by the positive responses they received from the vast majority of the patients during the telephone calls and motivational interviewing sessions.

All patients expressed favorable views and enthusiasm for the SingHypertension intervention and used words like "very lucky" "very thankful" "happy" "good" or "helpful" to describe it. Most felt fortunate to receive different components of intervention, including a discount on SPC medication, and expressed their gratitude as the intervention helped them improve understanding of their condition, increased its acceptance, and enhanced their knowledge about following a healthy diet and managing their overall health.

> I just want to express my very… thankful lah you know lah this kind of programme that there is. Uh in a way you know it helps me in a lot of thing, managing all that kind of thing. And then uh and of course… improving myself in understanding the… sickness itself lah yah. Yah there's some other… After the survey or interviews, the talk, the motivation, talk about the nurses, about the doctors. That helps a lot ah. I would like to thanks that ah. (Patient 4)

In addition, most patients mentioned that interactions with the doctors during consultations and with nurses over the calls were very helpful and informative. These interactions provided guidance and necessary knowledge about their condition,

medications and their side effects, importance of taking them regularly, and how to maintain a healthy lifestyle, improving their overall understanding and encouraging to take responsibility for their own health.

> First, I think it increases your awareness of your own. Your own condition, right? And when it increases your awareness, you take responsibility to make sure that you remain healthy. I think, for us all, it's being healthy and if possible, not having to take tons of medications. (Patient 16)

Burden: The Perceived Amount of Effort That is Required from the Participant to Participate in the Intervention

The physicians and nurses had different roles to play in the study, and different protocols to implement. The former was primarily involved in the implementation of the algorithm during their consultation, and the latter was assigned to perform motivational conversation to high-risk patients and conducting telephone-based follow-ups guided by a checklist and motivational interviewing techniques. Therefore, these two groups of participants perceived different amount of efforts.

Most physicians described the participation in the intervention as limited effort and manageable over time, especially given the availability of a systematic protocol, and adequate training and support. They also commented that the intervention required the same amount of effort they usually put on any regular polyclinic patient with suboptimal control.

> I didn't think it had a huge strain on my usual practice. Because patients with hypertension were basically patients that we saw on a daily basis.… after the first few recruitments, it was not too difficult to be familiar with the entire recruitment process, as well as what were the tests to order for the patients.…. So, overall, I didn't think it was difficult to implement most of the essential bits of the research itself. (HCW16, Physician)

Most nurses felt that they did not find it difficult to perform intervention activities such as motivational conversation, phone calls and administrative duties. However, some nurses expressed that accommodating motivation conversation and telephone follow-ups in their busy routines work was challenging, as dedicated time was not allotted for these activities due to manpower shortages.

> Okay the only problem here was, they didn't give us time to make the calls, we have to do in between our patients so sometimes we had a build-up of the calls and to do this we rotate and at the same time when we were in the injection room, vaccination room it is very difficult to do these calls because we have back to back patients side. And sometimes we had to do the motivational counselling, the patient will be here in the clinic and they will bring to us to do the counselling, they had to pull me out of the injection room just to do the counselling. I can't do it there, then bring the patient over here, so its interruption to the service area also. So they should give us may be an hour or so for the calls and complete all the documentation that will be good. (HCW18, Nurse)

Almost all the patients found the intervention to be manageable and mentioned that receiving the nurses' motivational phone calls were not time-intensive, and were described as "easy", "not difficult", "not cumbersome", or "not a disturbance". They also felt that the questions asked by the nurses during the calls were quite straightforward.

> No, at most 5 mins it's not tough la… Effort aah… you just have to, may be 10-15 mins like that, no even 15 min, you just have to, sometime certain question, you just have to recall all that. (Patient 18)

> The call is like uh… once a month or something like that. So it doesn't take up a lot of time. Uh, yah to me it doesn't… take a lot. It doesn't take a lot to be part of the programme. (Patient 03)

Moreover, two patients mentioned that the nurses accommodated their schedules by calling at a convenient time or by calling back if the initial call was missed.

> Oh the call are usually very short. Just asking how is the recent reading, and uh whether or not is there any big changes in the reading, that kind of thing. So it doesn't take a lot of effort (Patient 03)

Ethicality: The Extent to Which the Intervention Has Good Fit with the Participant's Value System

Most participants agreed that the purpose of SingHypertension MCI aligned with their goals towards managing polyclinic patients with hypertension. These goals included empowering the patients to take control of their diet and lifestyles, increasing treatment compliance, or using a multicomponent approach to manage chronic conditions. Additionally, few participants also mentioned that the intervention helped gradually build trust between the patient and HCPs, which could potentially improve health outcomes.

> It did fit in the sense that ... I would say that the management of chronic diseases should be multiform. So, by doing the motivational interviewing, I believe they would be informed of lifestyle changes, food choices, which might not be repeated on every doctor's consult. I guess this is also a way of working on a non-pharmacological part to control the blood pressure as well. Then when the doctors see that they do not have to go into detail for that, they can concentrate on counselling about the medication and all that. So, multiform would be helpful. (HCW08, Physician)

> The study did do a lot of ... after the ... a two-year (time) of repeated calls and calls, I've noticed the momentum from the not-very-friendly become a very-friendly moment with the patients. What I mean is, in the beginning when we called the patients, the patient would have the Why-you-did-The-call-and-check kind of attitude. Then it changed to be "It's good that you call and ask me about all the blood pressure readings. (HCW09, Nurse)

Few physicians also raised their concerns about the higher costs of the SPC medication (Hyzaar) and the possibility of patients' unwillingness to continue it without any subsidy after the study.

All patients believed that the SingHypertension MCI was aligned with their values. A few patients even mentioned that they were provided extra care and special attention by the physicians as well as the nurses who had called to check on their health and progress.

> As I've said, I found this really showed you cared. It's not that I gave you the medicine, you went home and took it, and that's your business already. I was appreciative that you've taken extra care and time to talk to the patients and asked the patients 'how are you coping' because not everybody coped in the same way. (Patient 16)

> They come to care about me, ask me about my situation, and I will tell her the same. (Patient 15)

Intervention Coherence: The Extent to Which the Participant Understands the Intervention and How It Works

Most HCPs attended the initial training session prior to implementation of the intervention and the annual refresher training sessions after the intervention began. At the time of the interview, most of the HCPs reported a good understanding of the overall purpose and components of the intervention. A few of them also pointed out the similarities and differences between the existing polyclinic practices and the intervention.

> It's more about whether the blood pressure is optimum or not, why it's not optimum, or how we can manage ... to optimize the blood pressure, whether it's to increase the medication that is for the SingHypertension or whether it's via alternate medication, and if not, what else we can do. That's how we manage any patient with hypertension. So it's similar to the algorithm that we would usually use to manage any patients with hypertension, but just it had a specific medication. (…) I felt that when I was using the algorithm at the time it's just like managing any patients with hypertension. (HCW10, Physician)

Almost all the patients understood whether they were given a new combination medication (Hyzaar) to treat hypertension, if they received a discount on this medication, and the purpose of the nurses' phone calls.

> To keep us [on] track… If not… you know if we don't hear from the nurses or you know, we may not… use the drug, or we may not…adhere to the exercise program…it's a good reminder, at the same giving encouragement. (Patient 3)

Generally, they understood whether their own BP was too high and potential health complications of uncontrolled BP (ie stroke, organ failure, etc.). A few patients even described what foods to eat and what foods to avoid, as well as other lifestyle modifications that they should make to improve their health outcomes.

> Usually have exercise every day. But. I didn't eat too oily and salty diet like this. I cook it by myself, don't put it too oily and salty. (Patient 15)

Opportunity Costs: The Extent to which Benefits, Profits, or Values must be Given Up by the Participants to Engage in the Intervention

Most participants were able to participate easily in this intervention without feeling that they were giving up other activities or opportunities that they valued. They felt that the overall goal of the intervention complemented their own goals of hypertension management.

> I guess the goal for our SingHypertension program coincides with the goal of the management for patients with hypertension. Mainly we are targeting to, for their blood pressure to be controlled within the range. And also patients would be on regular follow-up with the clinic. It's actually advantage that in the SingHypertension program, nurses can do some follow-up care with the patient via the call on patient's convenience. We can check on patients whether they are truly monitoring their blood pressure at home, and are there any difficulties they are facing. Or any concerns they have regarding their blood pressure from their monitoring at home. (HCW01, Nurse)

However, few nurses mentioned that occasionally they had to give up their lunch and stay after office hours to accommodate patient's preference and ensure that they completed the follow-up calls within the study's stipulated timeline.

In general, the patients voiced sentiments similar to the HCPs. Most of the patients stated that they did not have to give up any benefits, values, or profits during the study. However, a few patients commented that they had to sacrifice certain foods which they considered "light" or minimal compromises and it did not affect their participation in the study.

> It doesn't take a lot to be part of the programme. (Patient 03)

> No I didn't have to give up anything. As I said, I am very happy you all did this. (Patient 19)

Perceived Effectiveness: The Extent to Which the Intervention is Perceived as Likely to Achieve Its Purpose

Many HCPs reported that the intervention was helpful in improving patient's BP control, awareness about hypertension and its complications, adherence to medications, and empowered the patients with self-management skills.

> The SingHypertension study, overall, is a good approach. It really helped certain patients to understand the value of taking it seriously about this disease. (HCW09, Nurse)

> I suppose because the study has different…what do you call fixed protocols for review right? And actually the study coordinator will call the patient up, ask them to come back for review, and therefore the patient will be much more compliant to the medication. And therefore probably, my impression is that probably they will reach the blood pressure target easily. I mean more easily. (HCW15, Physician)

An overwhelming majority of patients perceived the intervention to be effective. These patients believed that the intervention helped to increase their knowledge, nurses' calls acted as reminders and encouraged them to follow a healthy lifestyle and to meet their personal goals of stabilizing or decreasing their BP.

> I think why I got into the program was because my blood pressure was pretty high. But after I was on the program, I found it (was) stable. (Patient 16)

A few patients also mentioned that they learnt the importance of taking medications regularly to control their BP and the consequences of missing them.

> Okay. In fact, my blood pressure is very low now. So they say, oh, just to make sure that, you know, don't make it go up again, you just continue taking the medicine. (Patient 06)

Self-Efficacy: The Participant's Confidence that they can Perform the Behaviours Required to Participate in the Intervention

Participants were "quite confident" in performing the behaviours required to execute the various components of this intervention. The HCPs mostly attributed it to the extensive initial and refresher trainings which included discussions using real-case scenarios, uncomplicated and easy-to-use checklist, algorithm and protocols, and the familiarization of the intervention implementation over two years. Moreover, some participants reported to have gained confidence with change in patient outcomes (eg, improved treatment compliance) and positive responses from the patients.

> For me it's.I don't see any difficulties, I am fairly confident with the checklist, as well as (with the) titration and (the) initiation of the medication. I don't have any issues. (HCW03, physician)

> Very confident, actually, with the checklist. Because I know that I've covered everything I need to cover. So the checklist is very important. (HCW02, Nurse)

We assessed the patients' confidence in different aspects of the intervention that required them to monitor their health or change their behaviour to improve health outcomes, such as medication adherence, lifestyle modifications, and home-based monitoring of blood pressure. Most patients expressed self-efficacy and confidence in all aspects of the intervention. Most patients reported taking their medications regularly and felt confident about managing their medications independently.

> I think I am very confident about the medication. I trust in the effectiveness. I am religiously taking the medicine. (Patient 5)

Similarly, many patients stated that they were confident in making adjustments to their lifestyle to stabilize or decrease their blood pressure (ie changes in diet or exercise).

> Nothing difficult. (I am) also getting more and more confident (Patient 7)

A few mentioned cooking at home regularly, eating more fruits and vegetables, and reducing fried, salty, and high fat food intake. Furthermore, a few mentioned that they tried to increase their exercise by walking some additional steps or doing additional housework. For home-based blood pressure monitoring, many patients noted confidence in taking their own blood pressure and took it regularly.

Very few patients were either not confident in taking their blood pressure by themselves, or they lacked the necessary equipment to do so on their own.

Feedback on SingHypertension Intervention Further Adaptation for Wide-Implementation and Scalability and Telehealth

Recommendations for Improving the SingHypertension Intervention

When asked how the SingHypertension intervention could be improved, participants had some suggestions to improve to its components and overall implementation at the primary care level. Supplementary Table 1c shows illustrative quotes by stakeholder type on feedback on further adaptation and scaling up of SingHypertension intervention.

Most physicians proposed integration of algorithm into existing electronic medical records (EMR) system, and making a simpler and concise version to increase its ease of access and use. Some suggested to expand its scope by including other conditions like diabetes, high cholesterol; adding age-stratification, considering the cost of medications; and increasing the choice of medications, while making them accessible across clinics.

> I would say to have a group of medications. So, basically, it's like what the national CPG is, like, for certain comorbid (conditions), these are the medicines that are encouraged, rather than say, ok, if it fulfils this and this and this, you only give this medicine. That's not usually how we think, I mean, as physicians. (HCW08, Physician)

> Greater flexibility in allowing the clinicians to make more shared decisions with the patients on the choice of anti-hypertensive (agents). (HCW04, Physician)

Many nurses suggested to include in-person home visits, combining their follow-ups with doctors' 3- or 6-monthly reviews of patients. They proposed introducing the option of video conferencing, assess their adherence to treatment and lifestyle advice, conduct home BP monitoring; and provide timely support, especially to the elderly patients. A few nurses also suggested tweaking the current checklist or changing it such that the questions do not appear redundant to the patients, which is likely to improve patients' compliance and responsiveness to their call.

Most participants highlighted the need for a supportive leadership who should lead the programme in each polyclinic. This entails providing necessary resources (eg, phones with caller IDs), addressing study-related issues, training doctors and nurses, and ensure they have dedicated time for SingHypertension MCI activities, and provide translation services for multiethnic patient population, as needed.

> Caller ID number would be good. Patient's don't respond quickly because a lot of scam calls are coming, so they are very scared to take it from a private line. So that will be an area where a telephone with a number listed would be good. (HCW17, Nurse)

A few participants recommended to conduct regular review meetings between the nurses and doctors involved in the implementation of this intervention. This could effectively integrate the various components of the intervention. Two participants suggested to create team-based care ie the patients to be seen by the same group of doctors and nurses and thereby, establishing a continuity of care.

> Time is a very limiting factor in our clinic because we have a very high workflow that we see on a daily basis. Currently, we are trying to support team-based care. Maybe in the future, if this team-like model is improved to state that team members will see the same group of patients. We have our own group of doctors, nurses, and pharmacies that the patients are more familiar with. I think that could also help in such a program. Currently, we do have the team-like model, but it's not at a very optimum level. We neither have specific nurses to take care of this group of patients, nor care managers assigned to this specific group of patients. (HCW10, Physician, SHP-BM)

Some participants suggested that long-term subsidization of the cost of single-pill SPC medications would increase the sustainability of the programme at the polyclinics.

> So I believe if we can subsidize more of the combination medicines, I think it would improve the control and the compliance much, much more. (HCW03, Nurse)

The patients also provided following suggestions on improving or extending the program to other clinics: targeting the study to a specific audience; ensuring good coordination among physicians, dietician, and researcher; training nurses on how to obtain additional information from the patients; sending encouraging text messages and reminders to improve lifestyle; engaging in conversations with elderly patients to better understand their issues; initiating a support group for patients with hypertension; and disseminating study information through social media or by television advertisements.

Scalability and Applicability of the Intervention

Finally, participants were asked if they would recommend the SingHypertension intervention to be implemented across other polyclinics in Singapore and to manage other chronic health conditions.

Most of the HCPs commented that they would "definitely" recommend implementation of this intervention at other polyclinics, and all the patients voiced similar opinion as well.

> Yes, definitely. Because I think a lot of our hypertensive patients, they were on multiple drugs. So if we could reduce the number of medications that they were taking, and also if, at the same time, we tried to identify which were the patients who were in the higher risk group and be more aggressive with their treatments, I think that definitely would improve the outcomes for our patients as a population. (HCW16, Physician)

Participants recommended the SingHypertension intervention to manage other chronic conditions (eg, diabetes, hyperlipidaemia, heart disease, and kidney disease) and to address modifiable lifestyle factors (eg, smoking). Some HCPs even suggested the use of an integrated protocol to manage patients diagnosed with diabetes, hypertension and hyperlipidaemia.

Two participants recommended more flexibility in the choice of anti-hypertensive medications and they felt that the existing guidelines is sufficient to manage other conditions, respectively.

Patients Views on Telehealth

In view of the usage of telehealth and remote consultations due to COVID-19 pandemic, and possibility of increase in uptake of this method of care in the future as well, patients were specifically asked about their views on using telehealth. They mentioned its advantages such as human interaction still being present, it being a good option when one cannot consult in person (eg due to COVID or other reasons), and the ability to avoid crowds in clinics. However, patients also mentioned challenges such as inability to perform physical examination or intervention when needed, difficulty due to technical issues like connectivity, lack of knowledge about using technology, not appropriate for elderly with serious health conditions, and the preparation time required. Between the option of in-person and telehealth, some patients clearly preferred in-person.

Discussion

Using TFA, our qualitative study reports 38 interviews of patients and HCPs (nurses and physicians) to assess the post-intervention acceptability of SingHypertension multicomponent intervention. All four critical components of SingHypertension intervention (1) motivational conversation by trained nurses, 2) telephone-based follow-ups, 3) treatment by trained physicians using a standardized algorithm with single-pill combination (SPC) antihypertensive medications, and 4) subsidy on SPC had high perceived effectiveness and a good fit with the value system and ethics of patients and HCPs. Most patients and HCPs expressed favourable views and were enthusiastic about the intervention. They understood the importance of the different components of the intervention in controlling blood pressure. Most HCPs appreciated the guidance from standardized training in hypertension management and believed that the intervention aligned with their goals of hypertension care. Despite some increased workload, the nurses felt rewarded for their positive interactions with the patients during the telephone follow-ups.

Most patients reported high self-efficacy, improved lifestyles, and adherence to antihypertensive medications. The limited choice of SPC medication, lack of subsidy beyond the trial duration, and shortage of nurses were significant challenges to wide-scale implementation. All HCPs and patients supported scaling up the intervention across all primary care clinics in Singapore.

Our findings are consistent with previous research studies done elsewhere which found multilevel or multidisciplinary interventions designed to manage hypertension,[13] and other chronic diseases (eg, advanced kidney disease)[14] are acceptable among patients and HCPs. A high level of acceptability has been reported in an integrated care intervention to treat hypertension and diabetes mellitus, and HIV.[15] Implementing an SPC therapy for atherosclerotic cardiovascular disease was deemed acceptable because of the perceived increase in adherence, a better understanding of the medication, and ease of treatment, among other reasons.[16]

Our results show that the HCPs held a positive attitude toward the intervention and its components. Several benefits were mentioned regarding the MCI intervention, the primary one being the opportunity to build trust with the patients and educate them on desired self-care behaviours through frequent telephone-based follow-up calls. This echoes previous research showing the importance of telephone follow-ups in empowering patients with hypertension with self-efficacy in performing the desired self-care behaviors.[17–19] Another key benefit of the MCI intervention reported by the participants was the use of SPC antihypertensive medication, which they believed effectively addressed pill burden, improved medication adherence, and reduced side effects and adverse events.[20] Some participants also reported that the algorithm helped make better treatment decisions related to hypertension management, especially for junior doctors. Thus, our intervention also adds to the existing literature on the benefit of enhancing HCP's knowledge regarding the management of hypertension.[21–24] In our study, most patients reported self-efficacy and voiced confidence in their ability to monitor their own blood pressure at home, and ability to modify to a healthy lifestyle and improve adherence to antihypertensive medications. They believed that the intervention was effective in helping them meet their personal goals (ie staying healthy, stabilizing or lowering blood pressure). These findings are consistent with the constructs of TFA of healthcare interventions,[8] suggesting high coherence, perceived effectiveness and acceptability of the intervention.

Although the stakeholders mainly supported the intervention, this qualitative study identified areas for optimization ahead of broader implementation. These include the integration of the treatment algorithm and checklists in the electronic

medical record system (EMR), allocating sufficient human resources and interpreters for ethnic minorities, upgrading clinic telecommunication systems with recognition features for the patients, frequent review meetings between the physicians and nurses, and availability of subsidized SPC medications in the long term.

Our study had several notable strengths. To the best of our knowledge, this is the first study in Asia to evaluate the acceptability of an MCI to manage blood pressure control at the primary care level. Our study contributes to the rapidly growing literature around TFA, presenting a primary care model in Asia to illustrate the significance of constructs for the proposed intervention. A hybrid inductive and deductive thematic analysis permitted using participants' data and mapping the same to TFA's themes to provide deeper insights into acceptability through its seven constructs. In addition, we included the perspectives of both the healthcare providers and patients, enhancing the robustness of the evidence regarding acceptability. The study had some limitations. We did not conduct pre-intervention acceptability before the intervention at baseline. Thus, any comparison on changes from before is not possible. Feedback on patients who dropped out from the study was not collected. Additionally, patients' family members or caregivers were not interviewed and their feedback was missed.

Furthermore, our data represents participants only from the four government-subsidized polyclinics clinics. However, all polyclinics provide subsidized care to residents in different geographic areas in Singapore and are regulated by the Ministry of Health with similar staffing ratios and other health systems and population characteristics. Thus, our findings would be generalizable to the vast majority of government-subsidized clinics in Singapore.

Hypertension remains a major global public health challenge, with less than 30% having BP control, even in high-income countries. Moreover, trends data show that BP control rates are worsening. Our findings show that SingHypertension MCI for managing hypertension integrated into the primary healthcare clinics in Singapore is acceptable to the key stakeholders and is recommended by them for scaling up.

Conclusions

Our post-intervention assessment of patients', nurses', and physicians' perspectives, strongly suggests that the SingHypertension multicomponent intervention is acceptable with a good fit and highly valued by the stakeholders in primary care clinics in Singapore. Nurses and physicians reportedly felt more rewarded despite an increased workload, which they managed well. Patients improved adherence to physicians' and nurses' advice and adopted healthy behaviour. Our findings of excellent acceptability in this qualitative study, coupled with previously reported effectiveness and affordability in SingHypertension cRCT, make a compelling case for scaling-up SingHypertension MCI in primary care clinics in Singapore and possibly other countries with similar healthcare infrastructure.

Registration

The healthcare providers and patients in this study had participated in the SingHypertension clinical trial. The trial is registered with Clinicaltrials.gov. The date of first registration is 23/11/2016 and the registration number NCT02972619.

Data Sharing Statement

The data underlying this article will be shared on reasonable request to the corresponding author, subject to approval from SingHealth institutional review board.

Ethics Approval and Informed Consent

The research study and all procedures involved were conducted according to the principles of the Declaration of Helsinki. Ethical approval for the study was obtained from the Human Research Ethics Committee at the SingHealth Centralised Institutional Review Board (CIRB) (Ref No: 2020/2644). All participants were informed about the procedures involved and they are free to withdraw from the study at any time without any consequences. A copy of the participant information sheet was also handed over to them and written informed consent was obtained.

Acknowledgments

We would like to thank the healthcare providers and patients who participated in the SingHypertension trial and current qualitative study for their willingness to participate.

Funding

The trial was funded by the National Medical Research Council, Singapore.

Disclosure

The authors report no conflicts of interest in this work.

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