

Effectiveness and Feasibility of a BCW-Informed WeChat Text-Messaging Intervention to Improve Medication Adherence After PCI: A 12-Week Quasi-Experimental Study

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Abstract

Background: Medication nonadherence after percutaneous coronary intervention (PCI) remains a major barrier to secondary prevention. Prior SMS-based interventions have shown inconsistent results, often limited to reminders without addressing behavioral or psychological determinants.

Objective: To evaluate the effectiveness and feasibility of a theory-informed, WeChat-based text-messaging program for improving adherence and patient-reported outcomes in post-PCI patients.

Methods: A nonrandomized, quasi-experimental parallel-group study with a mixed-methods design was conducted from July 2022 to April 2023 at a tertiary hospital in Hangzhou, China. Patients were allocated by ward admission to intervention or control groups. The intervention comprised a 12-week WeChat program with daily medication reminders and educational messages mapped to COM-B domains and behavior change techniques. The primary outcome was adherence (MMAS-8); secondary outcomes were medication beliefs (BMQ-Specific), self-efficacy (SEAMS), and health status (SAQ). Outcomes were measured at baseline, discharge, and 12 weeks by blinded assessors. Analyses used ANCOVA with baseline adjustment and multiple imputation. After 12 weeks, semi-structured telephone interviews with intervention participants explored usability, message clarity and relevance, reminder helpfulness, timing and tone, and unmet needs. Interviews were conducted by an independent researcher, purposively sampled until thematic saturation, and thematically analyzed from verbatim transcripts.

Results: Of 180 patients screened, 92 were enrolled and 87 (94.6%) completed follow-up. At 12 weeks, adherence was higher in the intervention group (adjusted mean MMAS-8, 7.38 vs 6.20; mean difference, 1.18 [95% CI, 0.95–1.41]; $P < .001$). Secondary outcomes also favored the intervention, including improved beliefs, self-efficacy, and quality of life. Feasibility benchmarks were exceeded, with deliverability 97.9%, retention 95.7%, and acceptability scores $>8/10$. Interviews confirmed usability and highlighted the need for personalization.

Conclusions: A theory-informed, WeChat-based program improved adherence, beliefs, self-efficacy, and quality of life after PCI. The intervention was feasible, acceptable, and scalable. Randomized trials are warranted to confirm long-term effectiveness and cost-effectiveness. Clinical Trial: Chinese Clinical Trial Registry (ChiCTR2200061353) <https://www.chictr.org.cn/bin/project/edit?pid=172238>

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Original Manuscript

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Trial Registration: Chinese Clinical Trial Registry (ChiCTR2200061353) <https://www.chictr.org.cn/bin/project/edit?pid=172238>

Keywords: Medication adherence; Percutaneous coronary intervention; Text messaging; mobile health; Behavior change techniques; COM-B model

Introduction

Percutaneous coronary intervention is the standard revascularization strategy for eligible patients with coronary heart disease, offering rapid relief of ischemic symptoms by reopening stenotic arteries [1]. Yet PCI does not halt the progression of atherosclerosis. Patients remain at risk of restenosis and recurrent cardiovascular events, with rates of restenosis of approximately 10% [2, 3]. For this reason, current clinical guidelines strongly recommend long-term, evidence-based pharmacotherapies for secondary prevention in patients with coronary artery disease, including after PCI, to reduce recurrence and improve outcomes [1, 4, 5].

In practice, medication adherence after PCI remains suboptimal. In the China PEACE cohort, nearly 30% of patients were poorly adherent, and one year adherence to aspirin and P2Y12 inhibitors was only around 50% [6]. International evidence shows similar patterns, with registry studies in the United States and Europe reporting that only 50 to 70% of patients remain adherent to dual antiplatelet therapy at one year and many

discontinue early [13–15]. Adherence rates in low and middle income countries are often lower, limited by financial, structural, and literacy barriers[7, 8]. Nonadherence is associated with an approximately 30–40% higher risk of cardiovascular events and mortality. [9–11], which highlights the urgent need for scalable and cost effective adherence support across diverse settings[12].

Mobile phone-based interventions, particularly text messaging, offer promise because they are inexpensive, widely accessible, and acceptable to patients[13] [14]. However, evidence from prior text-messaging interventions after PCI is heterogeneous, some studies have documented improved adherence[15–17], while others reported null or only short-lived effects[18–20]. Reported limitations include generic one size fits all content, weak alignment with patient capability, opportunity, and motivation, poorly timed reminders that are not matched to refill cycles or side effect periods, and limited integration with clinical workflows that can increase burden for patients and providers[14, 20, 21].

A key reason for these shortcomings is the lack of explicit theoretical frameworks in intervention design. Without theory, programs risk poor fidelity, limited transparency, and reduced scalability[14]. In our prior work, we applied the COM-B model to systematically identify barriers and facilitators to medication adherence among patients following PCI[22]. First, capability marked by restricted health literacy and uncertainty about side effects or dose adjustments. Second, opportunity characterized by barriers to refills, competing life demands, and limited communication with clinicians. Third, motivation reflected by declining perception of risk and concerns about bleeding or polypharmacy. The Behavior Change Wheel(BCW) extends COM B by linking these determinants to intervention functions and specific behavior change techniques, which establishes a systematic pathway from mechanisms to behavior[23]. Although BCW has been applied in lifestyle and chronic disease programs[24–26], its use in cardiovascular pharmacotherapy after PCI remains limited.

To address these gaps, we developed MedText PCI, a BCW informed SMS intervention delivered via WeChat. The program systematically mapped barriers to mechanisms of action and aligned message content, timing, and delivery with theoretically specified processes. We conducted a 12 week quasi experimental pilot to test feasibility, acceptability, and preliminary effectiveness, and we complemented the trial with post intervention qualitative interviews to contextualize outcomes and inform future implementation. This mechanism to message approach provides a transparent and reproducible pathway for scalable adherence support in post PCI care.

Methods

Design

A 12-Week, nonrandomized, quasi-experimental parallel-group trial.

Participants

Patients were recruited from the Department of Cardiology of a tertiary general hospital in Hangzhou, Zhejiang Province, China, between July 1, 2022, and April 30, 2023. Eligible participants met all of the following inclusion criteria: (1) age 18–75 years; (2) diagnosis of coronary heart disease according to World Health Organization (WHO) criteria and status post-PCI; (3) patient and family willingness to participate and cooperate; and (4) ownership of a mobile phone with the ability to use WeChat and telephone functions. Participants meeting any of the following exclusion criteria were not enrolled: (1) advanced heart failure (New York Heart Association [NYHA] class IV); (2) severe comorbid disease involving major organs (e.g., brain, liver, kidney) or other serious somatic conditions; (3) illiteracy or visual/hearing impairments precluding reading text messages; and (4) cognitive impairment, communication disorders, or major psychiatric illness. Eligible participants received a printed study information pack containing a cover letter, participant information sheet, informed consent form, and a prepaid, addressed return envelope. Participation was voluntary and uncompensated.

Sample Size

Based on pilot MMAS-8 data (Appendix 1) with an expected between-group mean difference of 0.40 and an SD of 0.70, the sample size for an independent two-sample comparison of means was estimated using a two-sided α of 0.05 and 80% power. Sample size calculations performed with PASS version 15.0 indicated that a minimum of 72 participants (36 per group) was required after accounting for an anticipated 10% loss to follow-up; this value therefore served as our recruitment target. A total of 92 participants were ultimately enrolled, with 46 in the intervention group and 46 in the control group, thereby exceeding the prespecified recruitment target.

Group Assignment and Blinding

Ward assignment served as the unit of allocation, with participants assigned based on ward admission to maintain workflow efficiency and minimize cross-contamination. Due to the cluster-level, behavioral nature of the intervention, participants and treating clinicians were not blinded. Outcome assessors and data-collection personnel were blinded to group assignment: identifiers were masked on case report forms, intervention logs were inaccessible to assessors, and separate teams were responsible for intervention delivery and outcome assessment to reduce potential bias.

Intervention

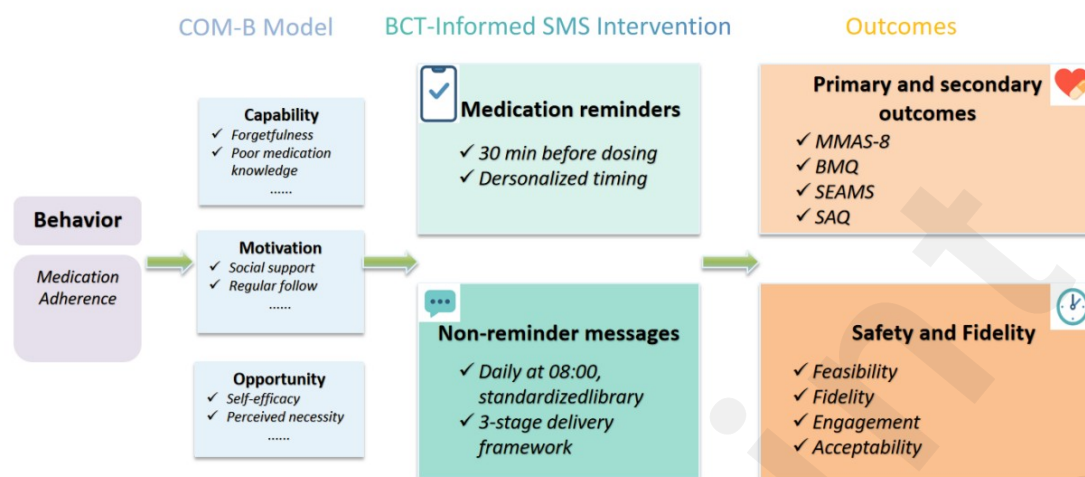
Participants in the control group received standard postoperative counseling on medication, physical activity, and diet, together with a printed education booklet on post-PCI care (Appendix 2).

In addition to usual care, participants in the intervention group received a BCW-informed text-messaging program delivered via WeChat, initiated immediately after hospital discharge. The program had two components. First, medication reminders were sent about 30 minutes before each participant's usual dosing time, based on baseline self-reported regimens[27]. Second, one non-reminder message was delivered daily at 08:00 for 12 weeks (Figure 1).

Non reminder messages were drawn from a standardized message library as detailed in Appendix 3. Development was guided by the Behavior Change Wheel. Adherence barriers were first identified using the COM B framework. Each barrier was then mapped to appropriate intervention functions and associated behavior change techniques. Candidate messages were drafted and refined by an expert panel according to these mappings. Wording and usability were informed by patient feedback from pilot testing. The final library covered medication information, management of adverse effects, benefits of adherence, self monitoring strategies, behavioral techniques, and prompts for social support. Full development procedures and examples are provided in the Appendix 3.

Message delivery followed a three-stage framework (Appendix 4). Weeks 1–3 focused on capability building including PCI and medication knowledge, side-effect management, and self-monitoring skills. Weeks 4–6 emphasized motivation by reinforcing adherence benefits, providing behavioral feedback, and strengthening psychological and social support. Weeks 7–12 targeted opportunity through habit formation, environmental cues, planning for travel or busy schedules, and self-reward to support long-term adherence.

Participants could pause or unsubscribe at any time. Message delivery status (sent/delivered) was automatically logged; accounts that were unsubscribed or blocked were recorded as non-delivered for fidelity assessment. Safety procedures included instruction to contact a 24-hour on-call number in the event of adverse events or symptom worsening, triggering a predefined escalation protocol. Intervention fidelity, including the proportion of messages sent and delivered, was monitored throughout the study.

Figure 1 Mechanistic framework of a theory-informed text-messaging intervention after PCI

Measures

Outcomes

The primary outcome was medication adherence, assessed using the 8-item Morisky Medication Adherence Scale (MMAS-8)[28]. Secondary outcomes included medication beliefs, measured with the Beliefs about Medicines Questionnaire-Specific (BMQ-Specific)[29] domains of necessity, concerns, and the necessity-concerns differential; self-efficacy for medication use, assessed with the Self-Efficacy for Appropriate Medication Use Scale (SEAMS)[30]; and disease-specific health status, measured with the Seattle Angina Questionnaire (SAQ) across five domains[31]. All outcomes were assessed at baseline, discharge, and 12 weeks by trained assessors blinded to group allocation. All outcomes were assessed at baseline, at hospital discharge, and at 12 weeks by trained assessors who were independent of the intervention team and blinded to group allocation. Post discharge data were collected either by telephone or during face to face visits, according to participant availability.

Feasibility, engagement, and acceptability

Deliverability was defined as the proportion of attempted messages that were confirmed as delivered through platform receipts, with results reported separately for reminder messages and non-reminder messages. Fidelity was assessed across three domains. Dose was measured as the proportion of planned messages that were actually sent. Schedule was measured as the proportion of messages delivered within the prespecified time window, with reminders sent approximately 30 minutes before each scheduled dose and non-reminder messages sent once daily according to intervention phase. Content was measured as the proportion of messages that were consistent with the assigned behavior change technique and COM-B domain, independently coded. Engagement indicators included participant-level deliverability, withdrawals, and retention at 12 weeks. Acceptability was assessed at 12 weeks, with participants rating clarity and usefulness on a scale from 1 to 10. Success thresholds were set a priori to indicate feasibility: deliverability $\geq 95\%$, composite fidelity $\geq 90\%$, retention $\geq 80\%$, median acceptability ≥ 8 of 10, and opt-out $< 10\%$. Thresholds were informed by prior mobile health feasibility studies and adapted pragmatically for this pilot.

Post-intervention interviews

After the 12 week follow up, intervention participants were invited to semi structured telephone interviews to explore experiences with the WeChat text messaging program. The guide was developed with reference to the COM B framework and prior literature, reviewed by cardiology and behavioral science experts, and covered ease of use, clarity and relevance of non reminder content, perceived helpfulness of reminders, timing and frequency and tone, unmet informational needs, barriers and unintended effects, and suggestions for tailoring and implementation. Interviews were conducted by a researcher independent of intervention delivery. Each lasted about 20 to 30 minutes and proceeded after verbal informed consent. Audio was recorded, transcribed verbatim in Chinese, and de identified.

Purposive sampling sought variation by age, sex, baseline adherence, and engagement. A target of 15 to 20 interviews was set, with recruitment continuing until thematic saturation, defined as the point at which no new codes or themes emerged. Data were analyzed using thematic analysis following Braun and Clarke with inductive and deductive approaches[32]. Two researchers independently coded all transcripts, compared codes, and reached consensus through iterative discussion. Coding was managed in NVivo and an audit trail was maintained. Ethical approval for the qualitative component was obtained from the institutional review board.

Statistical analysis

All participants were analyzed according to their initial group assignment, regardless of adherence or follow-up status. For continuous outcomes, including MMAS-8, between-group differences at 12 weeks were estimated using analysis of covariance (ANCOVA), with treatment group as the fixed factor and the baseline value of the outcome as a covariate. Results are reported as adjusted mean differences with 95% confidence intervals and two-sided P values. Missing 12-week outcomes were addressed using multiple imputation by chained equations. Sensitivity analyses included complete-case analyses (excluding participants with missing outcomes) and additional models adjusting for other baseline covariates to assess the robustness of primary findings. Statistical analyses were conducted using SPSS version 25. Interview recordings were transcribed verbatim and analyzed using thematic analysis. Two researchers independently coded the transcripts, resolved discrepancies by consensus, and iteratively refined the codebook and emerging themes. Data collection and analysis proceeded concurrently until thematic saturation was reached. An audit trail was maintained to ensure transparency. Transcripts were managed in NVivo, and illustrative quotations were translated for reporting.

Ethical considerations

The study received ethical approval from the Ethics Committee of The First Affiliated Hospital of Zhejiang University (11T20220185B). Written informed consent was obtained for the quasi-experimental pilot, and verbal consent was obtained for post-intervention telephone interviews; verbal procedures were approved by the ethics committee and documented in study records. All procedures complied with Good Clinical Practice and the Declaration of Helsinki. Only de-identified data were analyzed, and access was restricted to the study team. Data handling complied with national data-protection regulations and institutional data security policies.

Results

Characteristics of the Study Population

Between July 1, 2022, and April 30, 2023, 180 patients were screened; 92 were non-randomly allocated to the intervention (n=46) or control (n=46) groups in this quasi-experimental study (Figure 2). Assigned care was completed by 44 participants (95.7%) in the intervention group and 43 (93.5%) in the control group. Attrition was low: in the intervention group, one death and one loss to follow-up; in the control group, one withdrawal due to malignancy and two losses to follow-up. The primary outcome was analyzed in the full cohort of 92 participants, with missing data imputed using multiple imputation procedures. Baseline

characteristics were similar between groups (Table 1). The mean (SD) age was 61.1 (8.5) years in the intervention group and 61.7 (5.6) years in the control group. Educational attainment was generally low, with 59.3% having junior high or below and 14.3% college or above. Most participants were retired (62.0%) or employed (38.0%). Monthly per-capita household income was <3000 RMB in 16.3%, 3000–5000 RMB in 52.2%, and >5000 RMB in 31.5%. Comorbid chronic disease was present in 59.8% of participants, and 53.3% were newly diagnosed with coronary heart disease.

Figure 2. CONSORT (Consolidated Standards of Reporting Trials) study flow diagram.

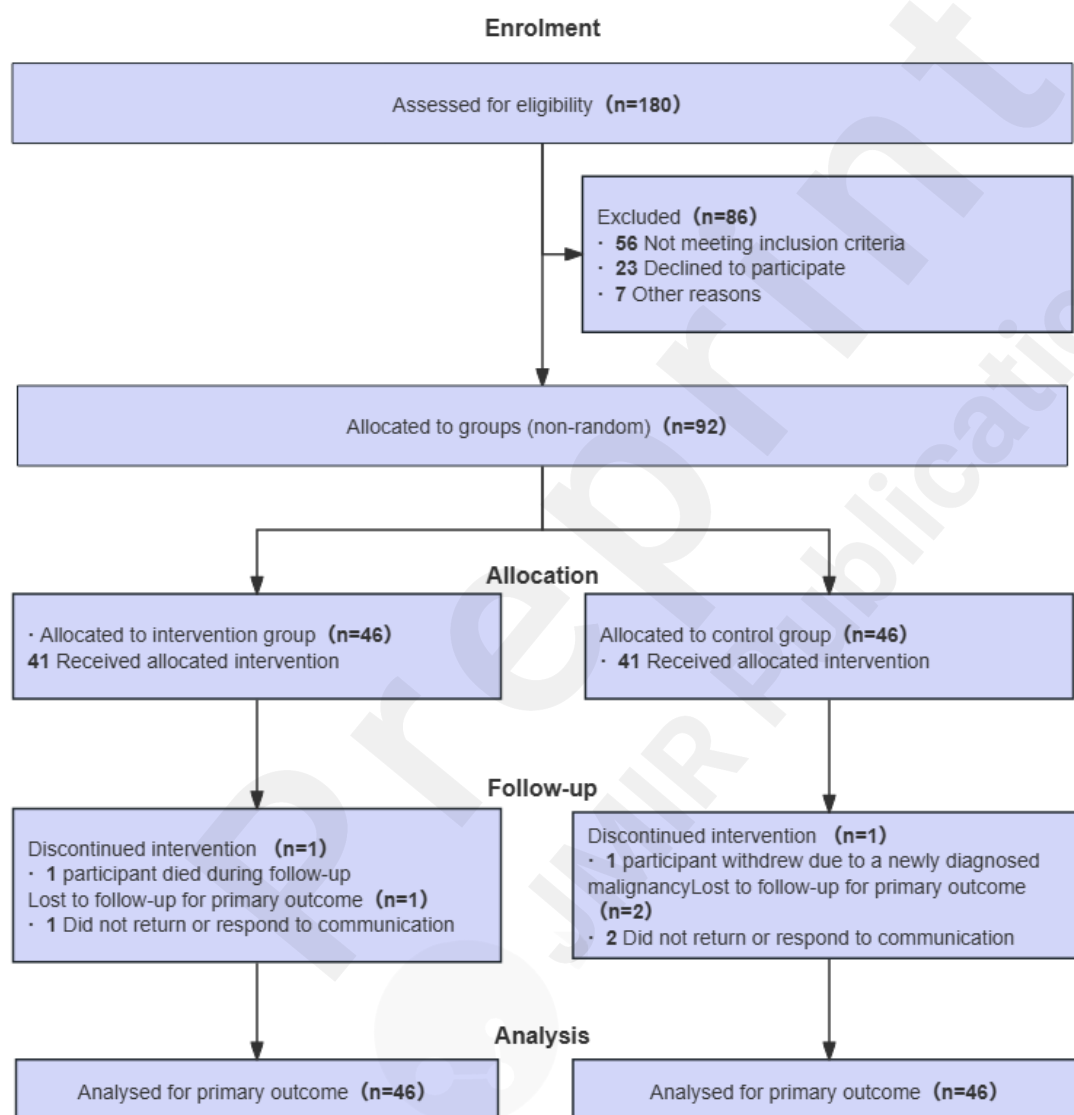


Table 1. Baseline data of participants completed the study

Characteristics	Total (n = 92)	Control (n = 46)	Intervention (n = 46)
Sex, n (%)			

Characteristics	Total (n = 92)	Control (n = 46)	Intervention (n = 46)
Male	73 (79.3)	34 (73.9)	39 (84.8)
Female	19 (20.7)	12 (26.1)	7 (15.2)
Age, mean (SD), years	61.74 (5.60)	62.11 (5.92)	61.11 (8.52)
Education, n (%)			
Junior high school or below	54 (58.7)	29 (63.0)	25 (54.3)
High school	24 (26.1)	13 (28.3)	11 (23.9)
College or above	14 (15.2)	4 (8.7)	6 (13.0)
Occupation, n (%)			
Employed	35 (38.0)	18 (39.1)	17 (37.0)
Retired	57 (62.0)	28 (60.9)	29 (63.0)
Monthly household income per capita, n (%)			
<3000 RMB	15 (16.3)	7 (15.2)	8 (17.4)
3000–5000 RMB	48 (52.2)	23 (50.0)	25 (54.3)
>5000 RMB	29 (31.5)	16 (34.8)	13 (28.3)
Comorbid chronic disease, n (%)			
Yes	55 (59.8)	28 (60.9)	27 (58.7)
No	37 (40.2)	18 (39.1)	19 (41.3)
First diagnosis of coronary heart disease, n (%)			
Yes	49 (53.3)	27 (58.7)	22 (47.8)
No	43 (46.7)	19 (41.3)	24 (52.2)

Medication Adherence and Secondary Outcomes

At 12 weeks, the intervention group recorded a higher MMAS-8 adherence score than the control group (7.38 vs 6.20; adjusted mean difference, 1.18 [95% CI, 0.95–1.41]; $P < 0.001$; Table 2).

Secondary outcomes pointed in the same direction. On the BMQ-Specific, participants in the intervention arm endorsed greater necessity and fewer concerns, yielding a wider necessity–concerns differential; SEAMS scores were also higher. Across SAQ domains, the intervention was associated with better physical limitation,

angina stability, angina frequency, and quality of life, whereas treatment satisfaction did not differ meaningfully between groups. The SAQ total score was higher with the intervention (adjusted mean difference, 6.13 [95% CI, 4.76–7.49]; $P < 0.001$).

Table 2. Primary and secondary outcomes at 12 weeks by group (ANCOVA adjusted for baseline of each measure)

Outcome	Intervention group (n=46)	Control group (n=46)	Adjusted mean difference (95% CI)	P value
	Adjusted mean (SE) 95% CI	Adjusted mean (SE) 95% CI		
Primary outcome				
MMAS-8 score	7.38 (0.08), [7.22~7.54]	6.20 (0.08), [6.04~6.36]	1.18 [0.95~1.41]	<0.001
Secondary outcomes				
Beliefs about Medicines Questionnaire				
BMQ–Necessity	22.46 (0.20), [22.07~22.85]	20.85 (0.20), [20.45~21.24]	1.62 [1.06~2.17]	<0.001
BMQ–Concerns	11.99 (0.22), [11.56~12.43]	15.25 (0.22), [14.81~15.68]	−3.25 [−3.87~−2.63]	<0.001
BMQ–Total score	10.54 (0.34), [9.86~11.21]	5.53 (0.34), [4.85~6.21]	5.01 [4.05~5.96]	<0.001
Self-efficacy for Appropriate Medication Use				
SEAMS	28.10 (0.29), [27.52~28.68]	24.06 (0.29), [23.48~24.64]	4.04 [3.22~4.86]	<0.001
Seattle angina questionnaire				
SAQ–Physical limitation	86.02 (0.79), [84.45~87.58]	77.80 (0.79), [76.23~79.37]	8.21 [5.99~10.44]	<0.001
SAQ–Angina stability	73.34 (1.97), [69.43~77.24]	60.36 (1.97), [56.45~64.27]	12.98 [7.45~18.50]	<0.001
SAQ–Angina frequency	93.04 (0.89), [91.28~94.80]	85.22 (0.89), [83.46~86.98]	7.82 [5.29~10.36]	<0.001
SAQ–Treatment satisfaction	83.83 (0.83), [82.18~85.49]	83.43 (0.83), [81.78~85.09]	0.40 [−1.94~2.74]	0.735
SAQ–Quality of life	71.60 (1.26), [69.10~74.10]	64.27 (1.26), [61.77~66.77]	7.33 [3.76~10.91]	<0.001
SAQ–summary score	75.30 (0.49), [74.34~76.27]	69.18 (0.49), [68.21~70.14]	6.13 [4.76~7.49]	<0.001

Table note: Values are estimated marginal means from ANCOVA, adjusted for baseline of each measure.

Positive adjusted mean differences indicate better outcomes in the intervention group.

MMAS-8, 8-item Morisky Medication Adherence Scale;

BMQ, Beliefs about Medicines Questionnaire;

SEAMS, Self-Efficacy for Appropriate Medication Use Scale;

SAQ, Seattle Angina Questionnaire;

SE, standard error;

CI, confidence interval.

Sensitivity Analyses

Sensitivity analyses confirmed the robustness of the primary findings: estimates from multiple imputation under a missing-at-random assumption were indistinguishable from complete-case results; per-protocol effects were comparable to intention-to-treat; and further adjustment for prespecified covariates (age, sex, education, medication count, comorbidity) did not materially change the effect size or significance. Detailed results are provided in the Supplementary Appendix 5.

Intervention Feasibility and Acceptability Outcomes

Deliverability was 98.7% for reminder messages and 97.9% for non-reminder messages, both exceeding the prespecified 95% threshold. Fidelity was maintained, with dose fidelity of 94.5%, schedule fidelity of 92.8%, and content fidelity of 95.3%, all above 90%. Participant-level deliverability reached 96.5%. Withdrawals were 2.2%, remaining below the 10% threshold, and the 12-week retention rate was 95.7%, surpassing the 80% benchmark. Acceptability at 12 weeks also met predefined criteria, with clarity rated at 8.7 (SD 1.1) and usefulness at 8.5 (SD 1.2) on 1–10 scales, both above the cutoff of 8.0 (Table 3).

Table 3. Feasibility, Fidelity, and Acceptability of the Intervention

Domain	Indicator	Intervention Result, % or Mean (SD)	Success Threshold	Met (Yes/No)
Feasibility	Deliverability (reminder messages)	98.7%	≥95%	Yes
	Deliverability (non-reminder messages)	97.9%	≥95%	Yes
Fidelity	Dose fidelity (sent vs planned)	94.5%	≥90%	Yes
	Schedule fidelity (sent within window)	92.8%	≥90%	Yes
	Content fidelity (alignment with BCT/COM-B)	95.3%	≥90%	Yes
Engagement	Participant-level deliverability	96.5%	≥95%	Yes
	withdrawals	2.2%	<10%	Yes

Domain	Indicator	Intervention Result, % or Mean (SD)	Success Threshold	Met (Yes/No)
Acceptability	12-week retention	95.7%	≥80%	Yes
	Clarity score (1–10)	8.7 (1.1)	≥8.0	Yes
	Usefulness score (1–10)	8.5 (1.2)	≥8.0	Yes

Deliverability was confirmed via platform receipts or participant confirmations. Fidelity included dose, schedule, and content. Engagement was assessed by participant-level deliverability, withdrawals (opt-outs), and 12-week retention. Acceptability was evaluated on a 1-10 scale at 12 weeks, reported as mean (SD).

Predefined success thresholds were: deliverability ≥95%, composite fidelity ≥90%, retention ≥80%, acceptability ≥8.0, and withdrawals <10%.

Post-intervention Interviews

Participants generally found the WeChat program easy to operate and seamlessly integrated into daily routines. Messages were described as clear and practical, arriving at appropriate times and helping patients remember doses and feel reassured. Perceived benefits extended to a warmer, encouraging tone and actionable tips. Reported drawbacks were modest and included occasional message fatigue, minor delivery delays, and limited personalization. Suggested improvements focused on tailoring content to individual medicines and comorbidities, allowing users to adjust timing and frequency, and enabling family or clinician involvement. Participants also proposed adding two-way interaction or human support, linking reminders to clinical care, and incorporating multimedia materials, refill or low-supply alerts, and stronger privacy/opt-out controls (Table 4).

Table 4. Themes, Subthemes, and Illustrative Quotes from Post-intervention Interviews

Theme	Subtheme	Illustrative quote
Ease of use and accessibility	Simple operation and easy access	"I didn't need to install anything new. The reminders came through WeChat, which I already check every day." (Male, 62 years)
	Integration into daily routines	"The messages popped up just before my usual pill time, so I could take my medicine right away without worrying." (Female, 59 years)
Clarity and relevance of content	Understandable language	"The language was clear and easy to follow, not full of medical jargon." (Male, 65 years)
	Practical relevance	"The travel tips were especially useful, because I sometimes forget when I'm away from home." (Female, 68 years)
Perceived helpfulness of reminders	Supporting adherence	"On busy days I might have forgotten, but the reminder made me stop and take my pills." (Male, 70 years)
	Psychological reassurance	"Even when I didn't strictly need it, the message made me feel cared for." (Female, 61 years)
Timing, frequency, and tone	Appropriate timing	"Getting the reminder about half an hour before my dose was just right—not too early or too late." (Male, 64 years)
	Positive and encouraging tone	"The tone was warm and encouraging, not like being ordered around." (Female, 56 years)
Unmet informational needs and suggestions	Desire for more personalized content	"I hoped for more advice about my other health problems, not just the heart medicines." (Male, 67 years)
	Suggestions for improvement	"It would be good if my family could also get the reminders, so they can check on me." (Female, 63 years)
Barriers and unintended effects	Message fatigue	"Sometimes the messages felt a bit too frequent, especially when I was busy." (Male, 58 years)
	Occasional technical issues	"A couple of times the messages came late, and I wasn't sure if the system was working properly." (Female, 60 years)
	Personalization and tailoring	"It would be better if the content was tailored to my own medicines and conditions." (Female, 66 years)

Discussion

In this quasi-experimental study, a WeChat-based text-messaging program improved medication adherence, treatment beliefs, self-efficacy, and disease-specific health status in patients with coronary heart disease. Deliverability and retention were high, and participants consistently characterized the messages as clear, timely, and supportive, indicating that digital adherence support can be feasibly embedded in routine care.

Unlike several high profile SMS trials, this study showed clear gains in medication adherence. The TEXTME trial reported modest reductions in cardiovascular risk factors but did not improve adherence or quality of life, reflecting infrequent delivery and generic lifestyle messaging rather than medication focused behavior change[33]. The StAR trial improved blood pressure control yet produced mixed patient reported outcomes, with an emphasis on reminders and self monitoring that did not address deeper motivational barriers[34]. Whereas Text4Heart showed short-term adherence gains that were not sustained[20]. Collectively, these trials suggest reminder-dominant messaging may ease forgetfulness but often fails to shift intentional nonadherence without targeting beliefs and motivation.

Contemporary reviews converge that medication nonadherence reflects both unintentional execution failures (eg, forgetting, routine disruption) and intentional decisions driven by beliefs and motivation [35, 36]. Building on this evidence, our intervention was explicitly designed—and in this study observed—to target both pathways. Timely prompts before dosing functioned as contextual cues that reduced reliance on memory, helping embed pill-taking into daily routines and strengthening opportunity in the COM-B model[37]. On the intentional pathway, nonadherence often reflects doubts about necessity, concerns about adverse effects, and ambivalence toward long-term therapy. Our educational messages improved understanding of PCI medications and the practical management of side effects, while motivational content reframed treatment appraisal by increasing perceived necessity and easing concerns[38]. The widening of the necessity–concerns differential, together with gains in self-efficacy, is consistent with this mechanism[39]. A supportive, empathetic tone also reduced anxiety and fostered relatedness, which can sustain motivation. By engaging capability, opportunity, and motivation concurrently, the program likely activated multiple mechanisms and produced synergistic effects[40]. Residual confounding cannot be excluded; future randomized studies with formal mediation analyses will be valuable.

An important and unexpected finding was improvement in disease specific quality of life. Participants reported fewer angina episodes greater symptom stability less physical limitation and higher scores in the quality of life domain. A plausible pathway links theory based content to stronger necessity beliefs and higher self efficacy which in turn support better adherence more consistent pharmacotherapy and more stable symptom control leading to functional recovery and better quality of life[41]. Formal mediation was not performed and will be prioritized in future longitudinal or structural equation models. These results differ from many prior texting trials and suggest that addressing both unintentional and intentional barriers together with emotional reassurance may be necessary to move outcomes valued by patients.

Additional mechanisms may also have contributed. Education and practical strategies can raise patient activation and disease management skills. Higher activation is linked to better engagement and improved quality of life in cardiovascular care[42]. The supportive tone and perceived connection may have reduced anxiety and strengthened self regulation. Anxiety is associated with worse angina related health status, while social support is positively related to adherence and quality of life in cardiac populations[43, 44]. By combining timely reminders with educational, motivational, and supportive content, the program addressed both unintentional lapses and intentional resistance and also enhanced activation and emotional reassurance. This multifaceted approach provides a coherent explanation for the broader gains in quality of life observed in this study.

Treatment satisfaction did not differ between groups. Satisfaction is shaped mainly by interpersonal care, continuity, and access[45], which were the same in both arms. The intervention targeted adherence rather than relational and service attributes captured by the SAQ treatment satisfaction domain, and baseline scores were

high, creating ceiling effects. Twelve weeks may be too short for shifts in trust or shared decision making. These findings suggest digital tools complement clinician led care. Future work should link messages to clinical encounters, enable bidirectional communication with the care team, and include patient experience measures sensitive to communication and partnership[46].

Qualitative findings helped explain the mechanisms and set priorities for optimization. Participants described messages as clear, reassuring, and helpful, which supports the interpretation that the program strengthened capability and motivation and aligns with gains in beliefs and self efficacy. Two themes also marked the limits of a uniform approach. Many participants wanted personalization, and some reported occasional message fatigue when timing or content did not match individual needs. These insights suggest value in adaptive personalization. Future iterations can tailor content using baseline profiles from the Beliefs about Medicines Questionnaire and the Self Efficacy for Appropriate Medication Use Scale, allow users to adjust frequency within prespecified bounds, and link brief summaries to clinic visits. Together these refinements would move the program from a fixed sequence to a dynamic person centered support system while maintaining feasibility in routine care.

Implications and Future Directions

The program's delivery through WeChat facilitated engagement across diverse education and literacy levels, supporting its scalability in real-world settings. The combination of high feasibility and measurable improvements in quality of life highlights the potential of digital adherence interventions as low-cost, population-level strategies, particularly in resource-limited health systems. Nonetheless, durability remains uncertain; outcomes were assessed only to 12 weeks, and some participants reported message fatigue, emphasizing the need to optimize frequency and explore adaptive, personalized dosing of content. Generalizability beyond WeChat and outside the Chinese context warrants evaluation, as platforms and cultural expectations differ. Future trials should also incorporate cost-effectiveness analyses, given the potential for system-wide savings, and explicitly address equity by tailoring interventions for older adults, individuals with limited digital literacy, and socioeconomically disadvantaged populations. Embedding these tools into clinical workflows through integration of adherence data into electronic health records and engagement of family caregivers may further enhance effectiveness and sustainability.

Limitations

This study has several limitations. First, the quasi-experimental design without randomization, modest sample size, and single-center setting limit causal inference and generalizability. Second, the relatively short intervention and follow-up period precluded evaluation of long-term outcomes such as prognosis, sustained behavior change, or health system integration. Third, adherence was assessed by self-report, which may overestimate behavior; however, consistency with improvements in treatment beliefs, self-efficacy, and disease-specific health status supports the validity of the findings. Finally, the text messages were not personalized to individual barriers; although patients may face heterogeneous challenges to adherence, the intervention used a uniform library and identical message delivery across participants, limiting its capacity for tailored support.

Conclusions

This WeChat-based, BCW-informed text-messaging program significantly improved medication adherence, treatment beliefs, self-efficacy, and disease-specific quality of life in patients after PCI. By addressing not only forgetfulness but also the cognitive, motivational, and emotional determinants of adherence, the intervention achieved benefits beyond reminder-only approaches. These findings highlight the potential of low-intensity, scalable digital strategies to strengthen secondary prevention in routine care. Future research should confirm these effects in randomized controlled trials with longer follow-up, incorporate objective adherence metrics, assess cost-effectiveness, and leverage artificial intelligence to identify heterogeneous patient barriers and deliver more personalized, adaptive interventions for large-scale implementation.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that support the findings of this study are available on request from the corresponding author, Li Huahuang. The data are not publicly available due to restrictions e.g. their containing information that could compromise the privacy of research participants.

CRedit authorship contribution statement

Yong Fang: conceptualization, methodology, formal analysis, data curation, visualization, writing—original draft; Wenxiao Wu: methodology, formal analysis, investigation, writing—review & editing; Zhihao Han: methodology, formal analysis, investigation, writing—review & editing; Xi Zhou and Lai Wei: investigation (recruitment, data collection), resources; Mingyue Zhang, Dili Chen, Xinyue Xiang: investigation (intervention delivery, process management), project administration; Fanghong Dong: supervision (monitoring, quality control), validation; Lihua Huang: supervision, resources, funding acquisition, project administration, writing—review & editing.

Abbreviations

BCW: The Behavior Change Wheel

COM-B: Capability, Opportunity, Motivation – Behavior

PCI: percutaneous coronary intervention

SMS: Short Message Service

MMAS-8, 8-item Morisky Medication Adherence Scale;

BMQ, Beliefs about Medicines Questionnaire;

SEAMS, Self-Efficacy for Appropriate Medication Use Scale;

SAQ, Seattle Angina Questionnaire;

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Supplementary Files

Multimedia Appendixes

Pilot Data on Changes in Scores From Discharge to 1-Month Follow-Up.

URL: <http://asset.jmir.pub/assets/04acb78a4e3987a2eb8b9cbb3ad79118.docx>

The education booklet.

URL: <http://asset.jmir.pub/assets/7f5a147a2c19ae7d7f31343efcc846c1.pdf>

SMS Development Process.

URL: <http://asset.jmir.pub/assets/35142e341abe8c6e405ac7d0d67539db.docx>

WeChat Text-Messaging Delivery Plan.

URL: <http://asset.jmir.pub/assets/a9c6b4e09497c078b2f9c1cfde262f35.docx>

The results of the sensitivity analysis.

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