Research Brief

The effect of mobile application-based technology use on medication compliance and modification of risk factors in post PTCA cohort of patients

C.J. Devaraju [a, *], Nanjappa Veena [b], K.S. Sadananda [b], C.N. Manjunath [b]

[a] Department of Clinical Research, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Mysore, Karnataka, India
[b] Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Mysore, Karnataka, India

A R T I C L E   I N F O

A B S T R A C T

Mobile application-based technology was used to study medication compliance and influence on cardiovascular lifestyle in ischemic heart disease (IHD) patients who undergo percutaneous transluminal coronary angioplasty (PTCA). The Mobile-app was made available at Google play store; the app was downloaded and instructions to use were thought to patients by the research team during hospitalization in the study group. A total of two hundred patients with ischemic heart disease who underwent PTCA were enrolled into the study. The control group had telephonic follow up at periodic interval. Both groups had clinical follow ups at appropriate time intervals. Higher medication compliance, smaller number of adverse events and regular follow ups were significantly more in mobile-app group than in control group.

1. Introduction

The future of healthcare lies in working hand-in-hand with technology. Digital app based technology could help transform healthcare systems into sustainable ones and can help in better monitoring and delivery of health care. It can help individuals to take care of their own health and empower them better to make decisions. Mobile application was developed to study treatment adherence and cardiovascular lifestyle in Ischemic heart disease (IHD) patients who underwent percutaneous transluminal coronary angioplasty (PTCA) at our institute. The mobile app was also updated with appropriate guideline directed learning materials to create awareness regarding cardiovascular health.

Progression of coronary atherosclerosis remains a significant problem after percutaneous transluminal coronary angioplasty (PTCA). In-stent restenosis and stent thrombosis are plausible complications that can occur in patients who undergo PTCA. It is also largely influenced by their compliance with medications especially dual anti-platelet therapy and statins. All cardiac patients need to modify their lifestyle in adapting healthy dietary and physical routines and controlling their risk factors like Diabetes, Hypertension which greatly influence the therapeutic outcome. Smoking cessation and limiting alcohol intake also influence the outcome.

Integration of technology with health care while maintaining patient confidentiality can help in ensuring prompt follow ups and early detection of complications which can be adequately treated. Use of technology to impart medical education is relatively new with promising prospects.

2. Methods

Institutional ethics committee approval was taken. The study had two groups; Group A-100 patients were enrolled into mobile application, where relevant information was updated monthly by patients for 6 months and Group B-100 patients were enrolled into the control group where telephonic follow up were done at 1month, 3month and 6 months. Both the groups were given standard care during the study. Both groups have visited the hospital for clinical follow ups at recommended designated intervals.

- The primary objective was to study the use of technology on ensuring clinical follow ups of post PTCA patients, ensuring

* Corresponding author.
  E-mail addresses: dr.devaraj@rediffmail.com (C.J. Devaraju), veenananjappa@yahoo.co.in (N. Veena), sadanand_dm@rediffmail.com (K.S. Sadananda), drcnmanjunath@gmail.com (C.N. Manjunath).

Table 1
Descriptive data.

Patient Characteristics	Mobile App (N-100)	Control (N-100)
Age (Mean)	54.62	57.28
Men	82	73
Post-menopausal women	13	24
BMI (kg/m^2)	23.9	23.6
EF (%)		
Mild	57	56
Moderate	09	09
Severe	00	02
ACS		
UA	04	07
NSTEMI	16	19
STEMI	74	71
CSA	06	03
Diabetes	46	32
Hypertension	50	42
CAG		
SVD	40	36
DVD	41	47
TVD	19	17
PTCA		
LMCA	03	01
LCX	20	16
LAD	47	48
RCA	46	37

Abbreviations: CAG-Coronary angiogram, BMI- body mass index, EF-Ejection fraction, STEMI- ST elevation MI, NSTEMI- Non ST elevation MI, UA- Unstable angina, SVD- Single vessel disease, DVD-double vessel disease, TVD- Triple vessel disease, LMCA- Left main coronary artery, LAD- Left anterior descending artery, LCX- Left circumflex artery, RCA-right coronary artery, PTCA- Percutaneous transluminal coronary angioplasty, and IHD-ischemic heart disease.

patient treatment compliance and study its effectiveness on modification of risk factors and adherence to lifestyle.
- Secondary objective was to study the effectiveness of technology on clinical cardiovascular outcomes; Outcomes included
  a. Primary: Fatal Myocardial infarction (MI), target lesion vascularisation, target vascular modification, Death due to cardiovascular cause.
  b. Secondary: Non-fatal MI, repeat hospitalization for cardiovascular cause,

We enrolled adults (Age ≥18yrs) who have undergone PTCA and willing to provide written consent. Subjects unable to use mobile app were excluded from the study.

Relevant data such as age, gender, clinical history, medication compliance and risk factors were obtained from all enrolled patients.

The app was made available both in English and regional language- Kannada. Baseline information and reports were updated at hospitalization in the institute and thereafter information was updated by the patient or relatives monthly. Patients received reminders at pre-designated intervals for updating their health information in the app[4]. They were instructed not to use the app as a replacement for a doctor and to seek medical attention if they were having warning signs or symptoms which were color coded as 'Red'. Any queries regarding their health status or minor symptoms were addressed via the app. Relevant health awareness materials regarding cardiovascular health was available for Group A patients in English and regional language Kannada. Patients were encouraged to study the information (Supplementary Fig. 1).

All patients (Group A and B) were assessed for quality of life of post PTCA during follow up. Patients were encouraged to update information such as symptoms, post procedure complication, treatment and dietary compliance and lab reports via mobile app, monthly.

Results: Medication compliance, smaller number of adverse events and regular follow ups were significantly more in mobile app group than in the control group: 89 vs. 78 ($p = 0.03498$), 03 vs. 15 ($p = 0.00149$) and 89 vs. 75 ($p = 0.00488$). Positive trend in cessation of smoking & alcohol, better physical activity, increased consumption of fruits daily, better quality of life, lesser number of deaths and readmissions were achieved in mobile application group, though they were statistically not significant (Tables 1 and 2).

3. Discussion

Digital app-based technology use has the potential to address medication compliance, clinical follow ups, modification of risk factors, and adherence to lifestyle thereby bridging the gap in delivery of health care and will also help in remote monitoring[2]. This was found to be especially useful during the COVID 19 pandemic[3], where approaching hospitals and seeking medical care had become increasingly difficult because of lockdown, transport availability and stigma attached to health care facilities being the nidus for virus transmission.

Mobile app technology not only improved treatment adherence, but also reduced adverse clinical cardiovascular outcomes. It also improved quality of life in Post PTCA patients. In our study, medication compliance, smaller number of adverse events and regular follow-ups were significantly better in mobile app group than in control group.

Device based technology may not be convenient in patients or relatives who are not literate and those with poor visual acuity.

Limitations: We included only patients or their close family members having an android phone as application had to be downloaded. A certain level of motivation and awareness were required even in learning the usage of application which itself translates as positive health seeking behavior in the test subjects. Our study though showed a positive trend in the study subjects, it cannot be extrapolated to general population as it is a small sample

Table 2
Comparison of Clinical outcome between mobile app and control group.

Clinical outcome	Mobile App	Control group	P Value
Death or Serious adverse events	03 (n-92)	06 (n-88)	0.29355
Readmission	01 (n-89)	04 (n-82)	0.14536
Medication Compliance	89(n-89)	78(n-82)	0.03498
Regular Follow up	89 (n-89)	75 (n-82)	0.00488
Mild Adverse Events	03 (n-89)	15 (n-82)	0.00149
Smoking cessation	29 (n-41)	26 (n-40)	0.29035
Alcohol cessation	23 (n-27)	18 (n-28)	0.07528
Lack of Physical Activity	04 (n-89)	17 (n-82)	0.00061
Consumption of Fruits	66 (n-89)	59 (n-82)	0.74521
Lost for Follow up	08 (n-100)	12 (n-100)	0.34578
Quality of life assessment	Better −87 (n-89)	Better −75 (n-82)	0.06581

size. Remote monitoring can only guide an individual patient, but it should not be a replacement for clinical follow ups.

4. Conclusion

Mobile app is an easy to use and patient interactive tool[1] . It appears to be a promising aid to improve treatment adherence, quality of life and decrease cardiovascular outcomes, especially in the long term. It is a potential tool wherein discharge checklist, guideline directed patient education material and follow-up reminders are incorporated for future use in both research and clinical practice for post PTCA patients.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ihj.2022.03.009.

References

1. Effects of interactive patient Smart phone support app on drug adherence and lifestyle changes in myocardial infarction patients: A randomized study Nina Johnston, MD, PhD, a Johan Bodegard, MD, PhD, b Susanna Jerström, MSc, b Johanna Åkesson, MSc, b Hilja Brorsson c Joakim Alfredsson, MD, PhD, d Per A. Albertsson, MD, PhD, e Jan-Erik Karlsson, MD, PhD, f and Christoph Varenhorst, MD, PhDa American Heart Journal, 2016-08-01, Volume 178, Pages 85-94, Copyright © 2016 The Authors.
2. Dorje T, Zhao G, Scheer A, et al. Smartphone and social media-based Cardiac Rehabilitation and Secondary Prevention (SMART-CR/SP) for patients with coronary heart disease in China: a randomised controlled trial protocol. *BMJ Open.* 2018;8, e021908. https://doi.org/10.1136/bmjopen-2018-021908.
3. Kamel H, Hafez MS, Bastawy I. Telemedicine improves the short-term medical care of acute ST-segment elevation myocardial infarction after primary percutaneous coronary intervention. *Front. Cardiovasc. Med.* 2021;8:693731. https://doi.org/10.3389/fcvm.2021.693731.
4. Mobile Phone Text Messages to Support Treatment Adherence in Adults with High Blood Pressure (SMS-Text Adherence Support [StAR]): A Single-Blind, Randomized Trial Kirsten Bobrow 1, Andrew J Farmer 2, David Springer 1, Milensu Shanyinde 1, Ly-Mee Yu 1, Thomas Brennan 1, Brian Rayner 1, Mosedi Namane 1, Krisela Steyn 1, Lionel Tarassenko 1, Naomi Levitt 1 PMID: 26769742 PMCID: PMC4750295. DOI: 10.1161/CIRCULATIONAHA.115.017530.