Efficacy of nurse-led cardiac rehabilitation on health care behaviours in adults with chronic heart failure: An experimental design

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ABSTRACT

Introduction: Nonadherence and poor health care behaviors contribute to worsening of heart failure symptoms, in many cases leading to increased morbidity and mortality.

Aim: To assess the efficacy of nurse-led cardiac rehabilitation on health care behaviours in adults with chronic heart failure. **Method:** An experimental design was conducted in India from January to December of 2019. A sample size of 200 adults with heart failure from a tertiary cardiac care center was enrolled. Participants were allocated into an intervention group (n = 100) and a control group (n = 100). A nurse-led cardiac rehabilitation program using a virtual educational video and reminder telephone calls was given to the intervention group for six months. A modified heart failure adherence and health care behaviours scale was used.

Results: 78% of the adults in the intervention group and 79% of the adults in the control group were males. 43% of the adults in the intervention group and 32% of the adults in the control group had ≥ 2 years of chronic heart failure. 42.27% of the participants in the intervention group and 35.05% of the adults in the control group indicated that medical follow-ups were essential. 21.65% of the adults in the intervention group and 13.40% of the adults in the control group expressed no difficulty adhering to the sodium restriction in the posttest. The participants in the intervention group had higher health care behaviours compared to control group, $p < 0.001$.

Conclusion/Implication: Cardiac nurses need to adopt cardiac rehabilitation in continuity of care for improving health care behaviours for adults with chronic heart failure.

1. Introduction

The prevalence of the cardiovascular disease is on the rise, and it is also a leading cause of death in India. Chronic heart failure (CHF) is a progressive syndrome with high morbidity and mortality despite recent improvements to its treatment.¹ Overall, it appears that CHF affects 1–3% of the general population and 10% of the older adults.² Estimates of CHF prevalence in the Asia region range from 1.26% to 6.7%.³ Nearly 6.5 million people in Europe, 5 million people in the USA, and 2.4 million people in Japan diagnosed with CHF. In China, 4.2 million people have CHF, whereas in India, between 1.3 and 23 million, and in Southeast Asia, 9 million people have been estimated to have CHF.^{4–6} Ischemic heart disease is the primary cause of CHF in the Asia-Pacific populations (27%–48%) and the Western populations (40%–58%).^{7–9} The comorbidities such as hypertension and diabetes were highly prevalent in Asian patients with CHF.^{8,10} CHF is a chronic progressive disease with the patient experiencing declining heart functions and

more frequent episodes of failure leading to low tissue perfusion.^{11,12}

Adults with complex comorbidities, higher body mass index have a significantly lower quality of life, physical functioning, role-physical, body pain, role-emotional, emotional wellbeing.¹³ Poor adherence and imperfect recollection of prescribed medication have been associated with a higher frequency of hospitalization in elderly patients.¹⁴ Positive self-care behaviours were correlated with higher income, higher education, lower body weight, and higher awareness of self-management.¹⁵ Behavioural factors such as nonadherence and delay in seeking care may contribute to readmissions and mortality.^{16,17} Barriers and facilitators to health care behaviours are highly related to nonadherence and health literacy.¹⁸ The prognosis seems inadequate among adults with CHF because of depression, psychosocial or behavioural deficits.¹⁹ Patients are at risk for readmissions and complications due to a lack of knowledge and social support.²⁰

Health care behaviours are fundamental to life style modifications for maintaining the quality of life among adults with CHF.^{21,22}

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Self-efficacy and self-confidence increases the confidence in adults in self-care behaviours, while nonadherence is a significant barrier to self-efficacy.²³ Adults with CHF are expected to adhere with self-care behaviours like maintaining follow-ups, medications, weight checking behaviour, exercise, and lifestyle modification. Lifestyle modifications improve the treatment plan and prognosis of patients with heart failure.²⁴ Educating patients about CHF treatment and the consequences of CHF has been shown to improve health care behaviours.²⁵ While medical treatment plans vary according to each stage of the disease, lifestyle changes such as smoking cessation, regular exercise, reduced alcohol intake are recommended strategies regardless of the stage of CHF.^{26,27} Daily consumption of 2–3 g of sodium in the CHF population, depending on CHF severity, is recommended.²⁸ Health care behaviours will be better improved if the nurses are planning and informing specific health promotion strategies along with decision making of the adults with CHF. A tailored educational program for adults contributes to better self-care and self-care management towards promoting quality of life. This emphasizes the importance of directing a nurse-led cardiac rehabilitation for adults with CHF to improve their health care behaviours and adherence. The aim of the study is to assess the efficacy of nurse-led cardiac rehabilitation on health care behaviours in adults with chronic heart failure.

2. Methods

2.1. Research design and approach

An experimental research design was used to evaluate the efficacy of nurse-led cardiac rehabilitation on health care behaviours in adults with chronic heart failure.

2.2. Ethics considerations

An institutional ethics approval and certificate was obtained from Sri Ramachandra Institute of Higher Education and Research with reference to IEC/07/21/Nov/2018. A written and verbal informed consent was obtained from the adults recruited in the study. Confidentiality and privacy for ensured for the participants. Participants could withdraw from the study at any time during and after the study without any consequences to clinical outcomes and health care.

2.3. Nurse-led cardiac rehabilitation program

The nurse-led cardiac rehabilitation program (NLCRP) for chronic heart failure was developed based on the hospital and national cardiac rehabilitation guidelines and tailored to the participant's cultural values, preferences, review of literature, and consultants' feedback. The NLCRP educational and practice components included recommendations on diet, exercise, medication, weight checking, smoking cessation, sodium restriction, fluid restriction, and lifestyle modification. An individual discussion with creative thinking and problem solving were used to deliver the cardiac rehabilitation to the intervention group. The virtual educational video on cardiac rehabilitation components was used to teach adults with CHF on an individual session for 3 h over five days (total of 15 h). A virtual educational video was created titled 'Healthy way to a Healthy Heart' focused on the educational and practice components to tailor to the needs of the adults in the intervention group. The virtual educational video was delivered to the participants after transition to home care. The NLCRP was validated by two cardiac clinical specialty nurses and one cardiac physician to finalize the NLCRP.

The researcher made a follow-up reminder telephone calls every fortnight (every 15 days) for a consecutive six months using a structured motivational interviewing. The motivational interviewing protocol consisted of check ins for appointment keeping, treatment adherence, exercise regimen, home care, active living, and lifestyle modification for

reinforcement and adherence to a cardiac rehabilitation program after discharge from the hospital. The control group was provided with the usual care, and standard discharge advise about prevention and care with chronic heart failure in the hospital. The pretest was done at baseline, posttest1 at the end of 3 months and posttest2 at the end of 6 months for intervention and control group.

2.4. Participants and setting

This study was conducted in a Sri Ramachandra Institute of Higher Education and Research cardiology clinical unit, a multispecialty tertiary hospital in India. Adults were recruited from the clinical cardiology center which included a coronary care, cardiothoracic intensive, cardiology, cardiac care, and rapid access units. The target population was adults diagnosed, treated, and managed for chronic heart failure and admitted to the cardiology clinical unit from 1 January to 30 December 2019. The participants were recruited based on the eligibility criteria: adults diagnosed to have chronic heart failure (coronary artery disease, dilated cardiomyopathy, or hypertensive heart disease), an ejection fraction $\leq 40\%$, New York Heart Association classification of Dyspnea Grade II and III and above 30 years. The exclusion criteria included cardiac surgery complications like a cerebrovascular accident, end-stage renal or liver disease and palliative care.

2.5. Recruitment and sampling

The sample size was calculated at 180 with a power of 80% at a level of significance of 0.05.²⁹ With a 10% attrition rate, a sample size of 200 was recruited, with 100 in each group. A simple random sampling was used with a lottery method to recruit the participants for this study. Two hundred adults were randomly assigned to the intervention group and control group using computer-generated block randomization. The intervention and control groups were affixed to 10 blocks each, and the 20 blocks were sealed individually in sequentially numbered. The opaque envelopes containing blocks were picked up from the box by the participants. The researchers, participants, and nurses were blinded to group assignments. One hundred participants were assigned to the intervention group and 100 participants were assigned to control group.

2.6. Measurements and outcomes

Modified heart failure compliance scale: Primary outcomes were adherence and healthcare behaviors of participants with choric heart failure. To assess the level of adherence, a standardized heart failure adherence and health care behaviours (AHCB) scale was used that comprised of 30 items.^{30,31} The AHCB scale was validated and modified, adding ten more items by the investigators. The modified heart failure AHCB scale has eight health behaviour components: appointment-keeping, medication, sodium restriction, fluid restriction, daily weighing, exercise, smoking cessation, and lifestyle modification. The modified heart failure AHCB scale is a self-administered questionnaire that consists of 40 items on a 5-point Likert scale. The tool was used to rate the difficulty in adherence to identify the barriers for adherence and the level of adherence for various health behaviour components. Patients were informed to state how important the health behaviour was by using a 5-point scale ranging from 0-Not at all critical, 1-Somewhat important, 2-Important, 3-Very important, and 4-Highly important. Adults were asked to identify whether they had difficulty in complying with the health care behaviour. Adherence was measured on a 5-point Likert scale: 0-None of the time, 1-Very seldom, 2-About half of the time, 3-Most of the time, and 4-All. Adults were asked to rate their adherence to the health care behaviour when they come for the follow-up to the hospital. Patients were asked to rate their level of difficulty in adherence to health behaviour. It was measured on a four-point scale, 0-No difficulty, 1-A little difficulty, 2-Moderate difficulty, and 3-A lot of difficulty. Adults were asked to express the barriers

to adherence to cardiac rehabilitation. Permission was obtained to use the standardized heart failure adherence and health care behaviours for the participants. Adults have grouped either adherent if they had been complying with health behaviour always/most of the time or non-adherent if they had been complying with health behaviour half of the time, seldom or never. Adults were considered overall adherent when they were compliant with six or more of the eight specific health behaviour recommendations. Adults were considered non-adherent when they were compliant with five or less of the eight specific recommendations. The AHCBS scale was validated by two cardiac clinical specialty nurses and one cardiac physician. The test-retest reliability of the modified heart failure compliance scale using the intraclass correlation coefficient was found to be 0.79.

The demographic and clinical measures were age, gender, education, occupation, residence, income, duration of illness, medical diagnosis, comorbidities, complexity, continuity of care, and home care supports.

2.7. Analysis

Statistical package for social science version 25.0 (IBM Corp. Armonk, NY) was used to analyze the data. Paired 't' test and ANOVA was used to analyze the data, $p < 0.05$ was accepted as a statistically significant. Anonymity of data and data security was ensured in the study.

3. Results

3.1. Demographic and clinical characteristics

65% of the adults with chronic heart failure were in the intervention group, and 66% of the adults were in the control group (Table 1). 50% and 41% of the adults lived in the urban places in the intervention and control groups, respectively (Table 1). Clinical characteristics: 43% of the adults who had more than two years lived with chronic heart failure in the intervention group, and 32% of the adults over two years were in the control group (Table 1).

3.2. Efficacy of nurse-led cardiac rehabilitation adherence

Intervention group: The posttest1 mean score was $\bar{x} = 3.89 \pm 1.814$ after the intervention of structured teaching program, which was significantly increased ($p < 0.000$) with a mean difference of 0.840 (Table 2). The posttest2 mean score and the mean difference was 1.289 from posttest1 to posttest two was significantly higher ($p < 0.000$) (Table 2).

Control group: The mean difference in the pretest to posttest1 was 0.69 ($p < 0.000$) (Table 2). There was no significant difference and mean difference (0.196) in the posttest1 to the posttest2 ($P = 0.203$) in the control group (Table 2).

3.3. Efficacy to adherence

The pretest mean difference was 0.680 between the intervention and the control group ($P < 0.002$) (Table 3). posttest1 and posttest2 had a high mean difference of 0.830 ($p < 0.001$) and 0.876 ($P < 0.000$), respectively, between the intervention and control group (Table 3).

The mean score in pretest ($\bar{x} = 3.01 \pm 1.381$), posttest1 ($\bar{x} = 3.89 \pm 1.83$) and posttest2 ($\bar{x} = 4.18 \pm 1.041$) was statistically significant for the intervention group ($p < 0.004$) compared to the control group ($\bar{x} = 2.39, 3.1$, and 3.3) (Table 4).

3.4. Efficacy of healthcare behaviors

In the pretest, majority of the participants in the intervention group were non-adherent with regard to appointment keeping, medication, weight checking, sodium restriction, fluid restriction, exercise, smoking

Table 1

Demographic and clinical characteristics of participants in intervention and control group.

Characteristics	Intervention (n = 100) F (%)	Control group (n = 100) F (%)
Demographic characteristics		
Age		
31–50 years	22 (22%)	17 (17%)
51–70 years	65 (65%)	66 (66%)
Above 70 years	13 (13%)	17 (17%)
Gender		
Male	78 (78%)	79 (79%)
Female	22 (22%)	21 (21%)
Level of education		
No education	14 (14%)	10 (10%)
Primary school	23 (23%)	22 (22%)
High school	45 (45%)	49 (49%)
Collegiate	18 (18%)	19 (19%)
Occupation		
Skilled	44 (44%)	45 (45%)
Professional	21 (21%)	20 (20%)
Retired	35 (35%)	35 (35%)
Living residence		
Urban	50 (50%)	41 (41%)
Rural	19 (19%)	25 (25%)
Semi Urban	31 (31%)	34 (34%)
Monthly family income (USD)		
<59.35 USD	41 (41%)	22 (22%)
59.36–89.02 USD	21 (21%)	23 (23%)
89.03–118.70 USD	13 (13%)	21 (21%)
>118.70 USD	25 (25%)	34 (34%)
Clinical characteristics		
Duration of heart failure		
<6 months	23 (23%)	21 (21%)
6 months–1 year	12 (12%)	15 (15%)
1–2 years	22 (22%)	32 (32%)
>2 years	43 (43%)	32 (32%)
Confirmed medical diagnosis		
Dilated cardiomyopathy	17 (17%)	9 (9%)
Hypertensive heart disease	5 (5%)	16 (16%)
Coronary artery disease	78 (78%)	75 (75%)
Co-morbidities present		
Yes	74 (74%)	85 (85%)
No	26 (26%)	15 (15%)

Table 2

Efficacy of nurse-led cardiac rehabilitation adherence in the intervention and control group.

Time intervals	Cardiac rehabilitation adherence score		Mean difference	Paired 't' test value	p value, significant***
	Mean	Standard deviation			
Intervention Group N = 100					
Pretest	3.05	1.445	0.840	4.071	0.000
Posttest1	3.89	1.814			***
Pretest	3.01	1.381	1.165	8.588	0.000
Posttest2	4.18	1.041			***
Posttest1	3.89	1.836	1.289	1.414	0.000***
Posttest2	4.18	1.041			
Control Group N = 100					
Pretest	2.37	1.574	0.690	4.963	0.000
Posttest1	3.06	1.556			***
Pretest	2.39	1.585	0.907	5.346	0.000
Posttest2	3.30	1.459			***
Posttest1	3.10	1.531	0.196	1.282	0.203
Posttest2	3.30	1.459			

cessation and lifestyle modification (Table 5). Most of the participants in the intervention group were adherent with regard to appointment keeping, medication, weight checking, sodium restriction, fluid restriction, exercise, smoking cessation and lifestyle modification in posttest2

Table 3

Efficacy to nurse-led cardiac rehabilitation adherence between intervention and control group.

Time intervals	Intervention group (n = 100)		Control group (n = 100)		Mean difference	't' test value	p value, significant***
	Mean	Standard deviation	Mean	Standard deviation			
Pretest	3.05	1.44	2.37	1.574	0.680	3.182	0.002 ***
Posttest1	3.89	1.814	3.06	1.556	0.830	3.473	0.001 ***
Posttest2	4.18	1.041	3.30	1.459	0.876	4.816	0.000 ***

Table 4

Repeated measures ANOVA to nurse-led cardiac rehabilitation adherence among intervention and control group.

Group	Pretest		Posttest1		Posttest2		F Value	P value, significant*
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Intervention group	3.01	1.381	3.89	1.83	4.18	1.041	0.595	0.004*
Control group	2.39	1.585	3.10	1.531	3.30	1.459		

Table 5

Distribution of health care behaviors to cardiac rehabilitation adherence to intervention and control groups.

Health Care Behaviours	Cardiac Rehabilitation Adherence						Cardiac Rehabilitation Non-adherence					
	Pretest		Posttest1		Posttest2		Pretest		Posttest1		Posttest2	
	F	%	F	%	F	%	F	%	F	%	F	%
Intervention Group N = 100												
Appointment keeping	35	35	41	41	65	67	65	65	59	59	32	33
Medication	64	64	82	82	90	92.8	36	36	18	18	7	7.2
Weight checking	12	12	13	13	23	23.7	88	88	87	87	74	76.3
Sodium restriction	56	56	65	65	74	76.3	44	44	35	35	23	23.7
Fluid restriction	36	36	55	55	77	79.4	64	64	45	45	20	20.6
Exercise	9	9	22	22	32	33	91	91	78	78	65	67
Smoking cessation	85	85	90	90	97	100	15	15	10	10	00	0.0
Lifestyle modification	4	4	13	13	23	23.7	96	96	84	84	74	76.3
Control Group N = 100												
Appointment keeping	23	23	25	25	33	34	77	77	75	75	64	66
Medication	42	42	70	70	78	80.4	58	58	30	30	19	19.6
Weight checking	6	6	4	4	3	3.1	94	94	96	96	94	96.9
Sodium restriction	44	44	56	56	56	57.7	56	56	44	44	41	42.3
Fluid restriction	28	28	50	50	47	48.5	72	72	50	50	50	51.5
Exercise	10	10	18	18	12	12.4	90	90	82	82	85	87.6
Smoking cessation	74	74	79	79	84	86.6	26	26	21	21	13	13.4
Lifestyle modification	10	10	4	4	7	7.2	90	90	96	96	90	92.8

(Table 5). Majority of the participants in the control group were non-adherent with appointment keeping, weight checking, fluid restriction, exercise and lifestyle modification, whereas most of the participants were adherent with medication and smoking cessation (Table 5).

4. Discussion

The results revealed the nurse-led cardiac rehabilitation had improved appointment keeping, medications, weight checking, sodium restriction, fluid restriction, exercise, smoking cessation, and lifestyle modifications in the posttest1 and posttest2 for adults in the intervention group. This means there were better efficacy of adherence and health care behaviours in the intervention group. The components of the health care behaviours in the intervention group gradually increased from pretest to posttest1 and posttest2. This suggests that the nurse-led cardiac rehabilitation program of 3 months and 6 months was helpful to improve the health care behaviours and adherence in adults with chronic heart failure. The adults who received only routine or usual care in the control group experienced a status quo or a minor change in appointment keeping, medications, weight checking, sodium restriction, fluid restriction, exercise, smoking cessation, and lifestyle modifications from Pretest posttest1 and posttest2. Adults with diabetes mellitus

exposed to telephone counselling and the structured had lower body mass index, blood glucose, and cholesterol levels leading to a better quality of life.³² Other studies show that compliance with medication and appointment keeping was higher than compliance with diet, fluid restriction, exercise and weighing with patient education.^{33,34}

The nurse-led cardiac rehabilitation program was statistically and clinically significant for efficacy and adherence scores from posttest1 to posttest2 in the intervention group. This suggests a need to enhance strategies to improve appointment keeping, medications, weight checking, sodium restriction, fluid restriction, exercise, smoking cessation, and lifestyle modifications in chronic heart failure. Adults who received the nurse-led cardiac rehabilitation enhanced their self-efficacy with chronic heart failure to improve their activities of daily living and continuity of care. Most adults with chronic illness have poor self-care behaviours (20.6%) and a low level of self-efficacy (31.3%), leading to decreased quality of life.³⁵ Adults with heart failure expressed better self-esteem and confidence with interventional therapies.^{36,37}

No significant difference was found in sodium and fluid restrictions compliance, whereas exercise performance increased, which was statistically significant at $p < 0.01$. Other studies showed that initially, 63% monitored their weight only at the medical visit and 21% monitored at least once a week.^{33,38} More prolonged illness and higher comorbidities

increased the risk of morbidity in heart failure.^{38,39} The control group had adherence only to medication, sodium and fluid restriction and smoking cessation components of cardiac rehabilitation in the Pretest and posttest2. Virtual educational videos and reminder telephone calls helped to improve the adherence for adults with CHF and can contribute to better health care behaviors. Adherence is an important factor affecting health care behaviours for adults with CHF.

The study observed a significant increase in adherence after participating in the cardiac rehabilitation in posttest1 and posttest2; the intervention group mean score. There was a significant increase in the mean scores of adherences at posttest1 and posttest2; the outcomes revealed that cardiac rehabilitation was significantly effective on adherence scores among the adults in the intervention group than the control group. Another study supported that adherence to exercise was good during supervised training but reduced during home-based training.^{33,40} After nine months of the study, there was a slight improvement, suggesting that supervision and support are required for these patients. Hence, the nurse-led rehabilitation positively affected physical and mental health care behaviours in adults with kidney disease.⁴¹

5. Limitations

The adults were selected from a single cardiac setting and did not gather data on self-efficacy, emotional and psychosocial wellbeing. There were no physiological parameters, access to health care, and desirability contributing to their health behaviour, such as smoking. Less affordability of purchasing a weighing machine. Matching was not done with confounders or age, gender, and other variables. ECG, Echo, scans and blood tests were not considered in this study.

6. Conclusion

Chronic heart failure affects the adult's adherence to self-care and activities of daily living. Nurse-led cardiac rehabilitation guidelines and standard help to improve adherence and healthcare behaviours among adults with chronic heart failure to improve their quality of life. NLCRP is important for adults to improve their self-care and self-management while adhering and complying with the treatment and health care. Social innovation strategies are needed to improve physical, mental, psychosocial, and emotional needs for adults with complexity of illness and for continuity of care. In conclusion, nurse-led cardiac rehabilitation program had increased efficacy with patient reported outcomes like adherence and healthcare behaviours. Monitoring weight, physical activity, and lifestyle modifications were critical elements of NLCRP for participants with chronic heart failure. This paper highlights the importance of cardiac care, active living and healthy lifestyles.

7. Implications

The nurse-led cardiac rehabilitation program can be delivered to patients with chronic heart failure in the hospitals, community, and home settings. The cardiac rehabilitation virtual educational video can be used to educate and instruct patients with chronic heart failure. Goal setting and commitment to change are important aspects of cardiac rehabilitation programs to maximize physical, psychological, and social functioning. Cardiac nurses could encourage tailored and individualized sessions to learn about adherence and healthcare behaviour strategies. Practice nurses could involve family members to enhance their knowledge of adherence and practice of healthcare behaviors to improving quality of life and health promoting behaviours. Nurses could schedule family and patient engagement in cardiac rehabilitation programs to pave the way for developing a cost-effective framework for home care. Clinical nurses could encourage group sessions to learn about adherence strategies to follow systematically, continuously, and daily. Utilizing this nurse-patient communication could involve family members to

enhance their knowledge on adherence and healthcare behaviours. Nurse-led cardiac rehabilitation program can contribute to better transitional care for adults and families in the community. The findings have been disseminated with the decision makers in healthcare and policy makers for preparing cardiac rehabilitation guidelines and implementation of care. Telehealth and rapid access clinics will support continuity of care and increase participation of patients. Further research studies can be conducted using a randomized control trial focused on improving person centered care through nurses in the home and community care. Further studies can be conducted using mixed approaches to assess the barriers and facilitators towards efficacy in cardiac rehabilitation. Multicenter studies can be conducted to assess the self-efficacy, adherence and healthcare behaviors in cardiac rehabilitation of patients and family support in home care.

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Porkodi Arjunan (PA) and Melba Sheila D'Souza (MSD) has made substantial contribution to conception and design, acquisition of data, analysis, and interpretation of data findings; been involved in drafting the manuscript, revising it critically for important intellectual content; giving final approval of the version to be published and agreed to be accountable for all aspects of the work related to accuracy and integrity of the work.

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Code of ethics in publishing

The study has been approved by the Sri Ramachandra Institute of Higher Education and Research, IEC/07/21/Nov/2018.

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This article has not been submitted to any journal and the work described has not been published previously in any form and is not under consideration of publication elsewhere.

Language

This paper was edited for grammar and communication by a native English academic and linguistic expert.

Submission checklist

We have adhered to the journal standards, scope, and author guidelines. We have uploaded Cover letter, Abstract, Main text and References, Tables, Figures and Title Page (Separate).

Declaration of competing interest

We declare there is no conflict of interest and no vested interests. The views expressed in this study do not necessarily represent the views of the individuals, institutes, and hospitals.

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