



## Original article

## An inpatient multidisciplinary educational approach to reduce 30-day heart failure readmissions



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## ABSTRACT

**Background:** Despite dramatic improvements in the management of heart failure (HF), hospital readmissions due to HF exacerbation remain high. To improve quality of care, many hospitals have developed interventions to reduce HF readmission rates. The aim of this study was to evaluate the impact of an inpatient multidisciplinary educational approach utilizing pharmacist to reduce 30-day HF readmissions. **Methods:** Retrospective observational study conducted at a tertiary-hospital in Tucson-Arizona, USA. It included adult patients admitted with a documented diagnosis of HF and excluded patients discharged to hospice. Patients were divided into two groups: intervention and control group. Intervention components included: (1) pharmacy student counseling; (2) HF education provided jointly by a pharmacist and a nurse as a group class to patients and caregivers and/or one-on-one education with a nurse; and (3) follow-up phone calls 1–3 days post-discharge reinforcing HF education. The main outcome was the rate of hospital readmission within 30 days post HF discharge.

**Results:** A total of 221 patients were identified in the intervention and 183 in the control groups. Of the patients in the intervention group, 44.8% received pharmacy student counseling, 47.1% received HF education, 25.3% were contacted 1–3 days post-discharge; and 5% received all intervention components. The difference in the primary outcome was not statistically different, with 3.8% readmission rate in the control group compared to 4.5% in the intervention group ( $p = 0.73$ ). It is worth to notice that none of the 11 patients who received all components of the interventions were readmitted. Univariate analysis demonstrated a significant association between pharmacy student counseling and 30-day HF readmissions ( $p = 0.03$ ); however, no difference was observed after adjusting for all variables.

**Conclusion:** The readmission rate in both groups was below national rate, and neither the intervention nor components were associated with a significant reduction in the primary outcome. Another study is needed to assess the rate of HF readmission in patients receiving all components of the multidisciplinary interventions.

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## 1. Introduction

Heart Failure (HF) is a serious medical condition that continues to raise over time and affects an estimated 6.2 million Americans between 2013 and 2016, which represent an increase from 5.7

million between 2009 and 2012 (Virani et al., 2020). Primary management of HF requires a multifaceted approach dealing primarily with the underlying conditions that may exacerbate a patient's symptoms. Management usually begins by first assessing the severity of a patient's HF, then choosing and initiating the appropriate treatment regimen.

Despite dramatic improvements in treatment outcomes, hospital readmissions related to exacerbation of HF remain high in many countries. The evidence revealed that all-cause 30-day readmissions due to HF exacerbation in Saudi Arabia can be as high as 37% (Alshibani et al., 2020). In 2012, the national all-cause 30-day readmission rate after HF admission in the U.S. and Canada was more than 20% (Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation, 2014; Canadian

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Institute for Health Information, 2012). The Centers for Medicare & Medicaid Services (CMS) defines a readmission as an unplanned admission to the hospital within 30 days of discharge. Medicare paid \$17.4 billion to hospitals in 2004 for unplanned readmissions (Jencks et al., 2009).

Because readmissions are expensive and may reflect quality of care, CMS has adopted different readmission measures for some diseases, including HF, and required hospitals to meet certain moving target. Hospitals who fail to meet the threshold for acceptable patient care level are subjected to financial penalties. Starting October 1, 2012, CMS began financial penalties against hospitals with high readmissions rates. To improve quality of care and reduce penalties, many hospitals have developed interventions to reduce HF readmission rates. Many of these interventions have included clinical pharmacists, as they have been shown to be an important addition to health care teams in improving patient adherence to pharmacotherapy of HF and reducing all-cause 30-day hospital readmissions.

Murray et al. (2007), for example, showed that when a clinical pharmacist assisted patients with outpatient pharmacotherapy, the patients had fewer hospital admissions and emergency department visits due to an exacerbation of HF. A meta-analysis study by Thomas et al. (2014) showed that providing inpatient HF education to older patients with HF and following up after discharge by hospital pharmacists contributed to a 25% reduction in HF readmission rates, with an absolute risk reduction of 19 cases per 100. Furthermore, McKay et al. (2019) published a systematic review and meta-analysis study, involving three studies, revealed that the rate of 30-day hospital readmission were significantly lowered when pharmacist-led transitions of care services focusing on discharge counselling and medications optimization and adherence for patients with HF (Hale et al., 2017; Truong and Backes, 2015; Moye et al., 2018). In contrast, Hansen et al. (2011) reviewed a wide variety of articles that used a diverse array of interventions either as a single intervention or bundle of interventions and did not conclusively find that any specific intervention was consistently effective in reducing all-cause 30-day readmissions.

The tertiary hospital, where the study was conducted, is an accredited HF center recognized by the Society of Cardiovascular Patient Care, and it has an all-cause 30-day readmission rate after HF hospitalization that is lower than the national average. In August 2013, the hospital implemented multidisciplinary team interventions utilizing pharmacy services to maintain the low HF readmission rate. This intervention included: the use of patient-centered counseling by pharmacy students, a course offered in the management of HF taught by a multidisciplinary team, and post-discharge follow-up phone calls. The purpose of this study was to evaluate whether these interventions reduced 30-day readmissions due to HF exacerbation only.

## 2. Methods

### 2.1. Study design

This observational study utilized a retrospective cohort design and conducted in a tertiary-hospital in Tucson, Arizona, USA. All patients identified with HF were offered the interventions detailed below. Patient involvement in the interventions was tracked by the HF coordinator and was recorded in a secure database. This study was approved by the hospital institutional review board.

### 2.2. Patient selection

Data were identified from the electronic records utilizing HF coordinator. Patients were included if their symptomatology

followed the HF coordinator's established identification algorithm (Fig. 1), and if they were 18 years of age or older. Patients discharged to hospice were excluded from the study. Patients who met the inclusion criteria between September 2013 and March 2014 were included in the intervention group. In order to remove the influence of factors other than the intervention, the intervention group was compared to a historical control group admitted between September 2009 and March 2010 for the management of HF. The timeframe for the control group was selected prior to penalties announced in the Affordable Care Act.

### 2.3. Patient identification

The hospital utilized a HF coordinator to screen the center's daily admission list for patients admitted with HF. Initial HF diagnoses could be modified to another diagnosis if additional results and information were available. In order to ensure that only HF patients were identified, the coordinator confirmed the HF diagnosis by looking for the patient's B-type natriuretic peptide (BNP) levels, reviewing health practitioner interdisciplinary care notes, and monitoring active inpatient medications. After the preliminary screening, each potential patient's record was reviewed for echocardiograms, consultations, and plans for care. If the diagnosis of HF was confirmed, the patient was eligible for interventions. The coordinator generated a HF list and sent it to the HF Team. This team included members of the following departments: Pharmacy, Nursing, Case Management, Outpatient HF Clinic Nurse, Director of Quality, Chief Quality Officer, Dietary, Therapy, and Respiratory Therapy.

### 2.4. Interventions

#### 2.4.1. Inpatient pharmacy student one-on-one counseling

After receiving a proper training by the pharmacy director, Introductory Pharmacy Practice Experiences (IPPE) students counseled HF patients on inpatient HF medications such as angiotensin converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), aldosterone antagonists, diuretics, hydralazine/isosorbide dinitrate, beta-blockers, and digoxin with emphasis on indication, impact on mortality, morbidity, and common adverse effects. At the time of counseling, a pharmacy student also identified whether the patient was on an ACE inhibitor/ARB or beta-blocker during the hospital stay and noted on the counseling documentation form if the patient is not on these medications, prompting the physician to evaluate appropriateness for initiation of such important agents since it is considered one of the quality measures determined by CMS for HF with reduced ejection fraction (EF).

Smoking cessation was also encouraged if appropriate. Pharmacy students requested the patients to sign the Arizona Smokers Help Line (ASHLine) consent form in order to participate in the state funded smoking cessation program. Adherence and tools to assist in adherence (i.e. pillboxes, medication lists) were also encouraged.

#### 2.4.2. Inpatient HF education

A nurse and pharmacist taught thirty-minute group inpatient HF classes two to three times a week to patients and their families and/or caregivers. Topics taught include the following items: what is HF, signs and symptoms of HF, HF medications and their impact on morbidity and mortality, adherence and tools to assist in adherence, the importance of physician appointments, monitoring signs and symptoms of HF and obtaining and recording daily weight, salt restriction and fluid restriction, limiting alcohol and caffeine, exercise as tolerated, smoking cessation, and HF self-management strategies. The patients who did not attend the class had the same

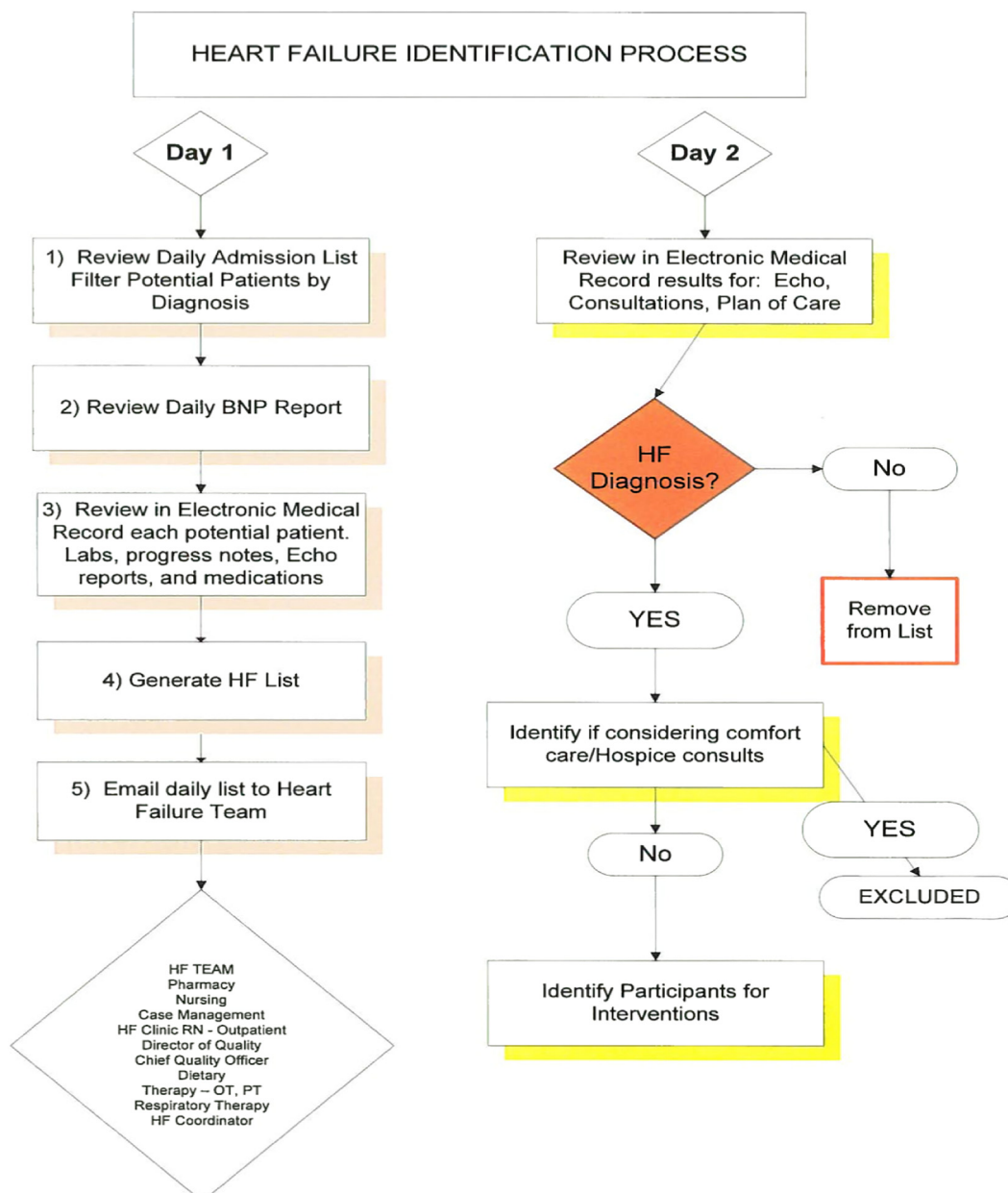


Fig. 1. HF identification algorithm.

information reviewed with the HF nurse in a 30-minute session. All patients were eligible for one-on-one counseling, but patients identified as high-risk were prioritized. High-risk patients were those who may be unable to afford their medications or unable to attend follow-up visits.

2.4.3. Follow-up phone calls

For patients discharged to home, the pharmacy students performed post-discharge phone calls within 1–3 days of discharge and any concerns were brought to pharmacy director. The discharge phone call inquired about the next physician visit, home health contact if relevant, daily weight, medication adherence, and issues with filling new medications. Issues were reviewed with a pharmacist and a case manager for follow up. To verify whether patients were admitted to a hospital other than the tertiary hospital within 30 days of discharge, pharmacy staffs were instructed to perform a follow up phone call 31 days post-discharge.

2.5. Outcome measures

This observational study was designed to evaluate the impact of a multidisciplinary approach utilizing pharmacy student counseling, one-on-one HF educational sessions, inpatient HF classes, and a post-discharge follow-up phone call on 30-day readmissions due to HF exacerbation only. The primary outcome was a dichotomous measure to indicate whether patients were re-admitted within 30 days due to HF exacerbation. This was determined by evaluating all admissions to the tertiary hospital. Another planned way to validate that a patient had not expired or been admitted to another facility was to make a phone call after 30 days post-discharge.

2.6. Statistical analysis

Data were analyzed utilizing a univariate and multivariate logistic regression analyses model to determine the odds of read-

mission for the intervention group compared to the control group. Variables included diagnosis, age, length of stay (LOS), last admission diagnosis (from the problem sheet), B-type natriuretic peptide (BNP), EF, ACE-inhibitor/ARB or beta-blocker use, in-patient pharmacy education, HF class attendance, smoker status, and pharmacy follow-up phone call. If the patient was readmitted, the readmission diagnosis was recorded. The sample size calculation was based upon an estimated effect size of a 10% decrease in readmissions, power of 80% and alpha of 0.05. The sample size needed to determine the difference in 30-day readmission was estimated to be 100 patients in each arm (Pal et al., 2013). Sample size estimation and analyses were performed using the statistical software Stata 12.1 by StataCorp, College Station Texas.

### 3. Results

A total of 183 patients in the control group and 221 patients in the intervention group were available for the analysis. According to the demographics and clinical characteristics of the patients (Table 1), the mean age of both groups was  $76.2 \pm 15.4$  years old. In the control group, there were significantly more smokers than in the intervention group (34.4% vs 10.8%,  $p < 0.001$ ). Moreover, patients in the control group had significantly higher mean lengths of hospital stay ( $5.12 \pm 3.57$  vs  $4.15 \pm 2.81$  days,  $p = 0.002$ ). The use of an ACE inhibitor/ARB agent or beta-blocker was significantly higher in the intervention group ( $p = 0.006$  and  $p < 0.001$ , respectively).

Of the 221 patients in the intervention group, 44.8% received pharmacy student counseling, 24.4% attended a HF class, 35.3% received inpatient HF nurse one-on-one education, 47.1% were successfully contacted 1–3 days post-discharge, and 5% received all components of the interventions (see Table 2).

As surrogate markers for HF severity that could possibly explain a difference in readmission rates, B-natriuretic peptide (BNP) and ejection fraction (EF) baseline values were compared between the two groups (Table 3). There was a significant difference in baseline BNP values between the intervention and control groups ( $p < 0.001$ ); however, it was not possible to identify which subcategory of BNP values resulted in this significant difference. Furthermore, there was no statistically significant difference ( $p = 0.46$ ) when comparing the EF percentage of the two groups.

The primary outcome result showed that there was no significant difference between the intervention group (4.5%) and the control group (3.8%) ( $p = 0.73$ ). It is worth to notice that none of the 11 patients (5%) who received all components of the interventions were readmitted. The univariate analysis showed only a significant association between pharmacy student counseling and the 30-day readmission rates due to HF exacerbation ( $p = 0.03$ ). The remaining variables did not show a statistically significant association (Table 4). After adjusting for all variables through multivariate logistic regression analysis, there was no significance difference

**Table 1**  
Baseline characteristics and primary outcome.

Variables	Control (N = 183)	Intervention (N = 221)	p-value
Age (Mean, SD)	75.6 (12.1)	76.8 (18.6)	0.44
Male (Mean, SD)	82 (44.8)	111 (50.2)	0.28
Smoker (n, %)	62 (34.4%)	23 (10.5%)	<0.001
Length of stay (Mean, SD)	5.12 (3.57)	4.15 (2.81)	0.002
ACE inhibitor/ARB use (n, %)	86 (47%)	134 (60.6%)	0.006
Beta-blocker use (n, %)	113 (61.8%)	185 (83.7%)	<0.001
<b>Primary outcome</b>	<b>Control</b>	<b>Intervention</b>	<b>p-value</b>
	<b>(N = 183)</b>	<b>(N = 221)</b>	
30-day readmission rates due to HF (n,%)	7 (3.8%)	10 (4.5%)	0.73

**Table 2**  
Frequency of intervention.

Intervention components	Intervention group (N = 221)
Pharmacy student counseling (n, %)	99 (44.8%)
Inpatient HF nurse 1-on-1 education (n, %)	78 (35.3%)
HF class (n, %)	54 (24.4%)
HF education (either Inpatient HF nurse 1-on-1 education or HF class) (n, %)	104 (47.1%)
Pharmacist post-discharge call (n, %)	56 (25.3%)
Received all intervention components (n, %)	11 (5%)

**Table 3**  
Values of BNP and EF in control and intervention groups.

BNP values Variables	Control (N = 183)	Intervention (N = 221)	p-value
No HF: <100 pg/mL (n, %)	2 (1.1%)	5 (2.3%)	<0.001
Suggests HF: 100–300 pg/mL (n, %)	24 (13.1%)	14 (6.5%)	
Mild HF: 301–600 pg/mL (n, %)	44 (24%)	21 (9.3%)	
Moderate HF: 601–900 pg/mL (n, %)	31 (16.9%)	33 (14.9%)	
Severe HF: greater than 900 pg/mL (n, %)	82 (44.8%)	148 (67%)	
<b>EF values</b>			
Variables	Control (N = 183)	Intervention (N = 221)	p-value
Normal: 55–70% (n, %)	52 (28.4%)	62 (28.1%)	0.46
Below normal: 40–55% (n, %)	37 (20.2%)	47 (21.3%)	
Suggests HF diagnosis: <40% (n, %)	13 (7.1%)	8 (3.6%)	
At risk of serious arrhythmias: <35% (n, %)	81 (44.3%)	105 (47.1%)	

**Table 4**  
Univariate logistic regression analysis of 30-day readmissions.

Variables	Odds ratio	95% Confidence interval	p-value
Intervention group	1.19	0.44–3.19	0.73
Age	0.97	0.94–1.00	0.09
Sex	1.59	0.59–4.27	0.36
Smoking status	0.78	0.22–2.79	0.71
Length of stay	1.05	0.92–1.20	0.49
BNP Categories	1.27	0.76–2.10	0.36
EF Categories	1.45	0.95–2.21	0.09
ACE inhibitor/ARB use	1.56	0.57–4.31	0.39
Beta-blocker use	1.69	0.48–6.01	0.42
Pharmacy student counseling	2.89	1.08–7.71	0.03
HF nurse 1-on-1 education	2.39	0.85–6.67	0.1
HF class	1.41	0.39–5.05	0.6
HF education (either education or class)	2.09	0.78–5.65	0.15

in the 30-day readmission rates due to HF exacerbation between the two groups (Table 5). Phone calls after 30 days post discharge were not attempted at all.

### 4. Discussion

The principal finding of our study was the inability of the multidisciplinary approach or any of its components to significantly reduce the 30-day readmission rate due to heart failure exacerbation only. One possible explanation for this may be that current practices have been influenced by the implementation of the Affordable Care Act (ACA), which may have led providers to prescribe more medications in accordance with national guidelines. To exclude these potential influencing factors other than the inter-

**Table 5**  
Multivariate logistic regression analysis of 30-day readmissions.

Variables	Odds ratio	95% Confidence interval	p-value
Intervention group	0.24	0.36–1.63	0.15
Age	0.98	0.94–1.01	0.22
Sex	1.27	0.43–3.76	0.67
Smoking status	0.66	0.17–2.56	0.55
Length of stay	1.04	0.89–1.21	0.63
BNP	1.23	0.69–2.21	0.48
EF	1.23	0.76–1.97	0.4
ACE inhibitor/ARB use	1.45	0.48–4.42	0.51
Beta-blocker use	1.15	0.28–4.71	0.85
Pharmacy student counseling	4.63	0.92–23.29	0.06
HF education (either education or class)	1.79	0.42–7.71	0.43

vention, the control group was selected from the pre-ACA implementation time period, while intervention group patients were selected post-ACA implementation and after all components of multidisciplinary approach were in place.

Although the estimated sample size of 100 patients for the intervention group was surpassed with a total number of 221 patients, only 11 patients received all components of the multidisciplinary approach. This low number may have been attributed to factors like the inability of the pharmacy students to be available at all times; the inability of patients to attend the HF class, since it was conducted only three times a week; and the inability to successfully contact most of the patients through post-discharge follow-up phone calls. Such factors reflect the challenges of applying such an approach.

The control group patients' significantly longer lengths of stay compared to those of intervention patients could possibly be explained by the fact that the criteria for discharge was different between the two time periods. In the past, hospitals were more conservative with discharging patients who are ready for discharge compared to nowadays.

Also, it is worth noting that the practice of administering an ACE inhibitor/ARB or beta-blocker for HF patients has improved, which could be due to the following factors: pharmacy students actively intervening and making sure HF patients are using these medications and identifying valid reasons if not; physicians being more aware that HF patients should be on an ACE inhibitor/ARB or beta-blocker if appropriate, and the availability of updated guidelines for the administering of these medications in HF patients. Unfortunately, none of the intervention components were associated with a reduction in the HF readmission rate. Interestingly, none of the 11 patients who received all components of the interventions were readmitted; however, a sub-analysis for those patients was not performed due to the small number. Additional efforts are required to improve the process so higher number of patients would receive all of parts of interventions. A future study evaluating the impact of all components of the intervention in a larger sample size is highly needed, especially in hospitals/countries with less confounding factors that could affect the results like the ACA and the adaptation of treatment protocols. For example, there is no penalties for 30-day readmission in Saudi Arabia and many hospitals have no protocol in place for managing and discharging HF patients. This create an excellent opportunity for researches, with few confounding factors, evaluating interventions that could potentially improve the quality of care and reduce 30-day readmission.

There was an initial plan to contact the patients 31-day post-discharge to make sure they had not died or been readmitted to another hospital for HF exacerbation; however, this piece of the intervention was never implemented due to staff shortages.

The univariate analysis showed an a significant association between patients who received pharmacy student counseling and rate of readmission, and this difference, which was not significant

after adjusting for all variables, could be due to the fact that patients who received the counseling were selected by the HF coordinator nurse and were perceived to be at a higher risk due to their lack of health insurance or family support.

This study includes some limitations. It was only conducted in one health care center, which could reduce its generalizability. It also includes the known drawbacks of retrospective studies, including the inability to measure all confounding variables. Furthermore, this study did not adjust for the increased risk associated with comorbidities. Additionally, the power of the study was reduced due to the low percentage of patients receiving all the components of the multidisciplinary approach as intended. Moreover, the readmission rate at the hospital was well below the national rate of readmission in both groups which could underestimate the impact of the interventions. Finally, the phone calls after 30 days post-discharge were not performed due to staff shortages which may underestimate the true rate of readmission since the rate of readmissions at other hospital was unknown.

## 5. Conclusions

This study found that the readmission rate in both groups was below national rate, and none of the interventions were associated with a significant reduction in 30-day readmission rates. However, this study was underpower to detect a difference. Another study, powered enough to detect a potential difference, is needed to assess the rate of HF readmission in patients receiving all components of the multidisciplinary interventions. Moreover, a follow-up analysis is needed to identify which patient populations, if any, are most likely to benefit from the interventions.

## 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.

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