Original Investigation

Effects of Telephone-Based Peer Support in Patients With Type 2 Diabetes Mellitus Receiving Integrated Care
A Randomized Clinical Trial

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IMPORTANCE In type 2 diabetes mellitus (T2DM), team management using protocols with regular feedback improves clinical outcomes, although suboptimal self-management and psychological distress remain significant challenges.

OBJECTIVE To investigate if frequent contacts through a telephone-based peer support program (Peer Support, Empowerment, and Remote Communication Linked by Information Technology [PEARL]) would improve cardiometabolic risk and health outcomes by enhancing psychological well-being and self-care in patients receiving integrated care implemented through a web-based multicomponent quality improvement program (JADE [Joint Asia Diabetes Evaluation]).

DESIGN, SETTING, AND PARTICIPANTS Between 2009 and 2010, 628 of 2766 Hong Kong Chinese patients with T2DM from 3 publicly funded hospital-based diabetes centers were randomized to the JADE + PEARL (n = 312) or JADE (n = 316) groups, with comprehensive assessment at 0 and 12 months.

INTERVENTIONS Thirty-three motivated patients with well-controlled T2DM received 32 hours of training (four 8-hour workshops) to become peer supporters, with 10 patients assigned to each. Peer supporters called their peers at least 12 times, guided by a checklist.

MAIN OUTCOMES AND MEASURES Changes in hemoglobin A_{1c} (HbA_{1c}) level (primary), proportions of patients with attained treatment targets (HbA_{1c} <7%; blood pressure <130/80 mm Hg; low-density lipoprotein cholesterol <2.6 mmol/L [to convert to milligrams per deciliter, divide by 0.0256]) (secondary), and other health outcomes at month 12.

RESULTS Both groups had similar baseline characteristics (mean [SD] age, 54.7 [9.3] years; 57% men; disease duration, 9.4 [7.7] years; HbA_{1c} level, 8.2% [1.6%]; systolic blood pressure, 136 [19] mm Hg; low-density lipoprotein cholesterol level, 2.89 [0.82] mmol/L; 17.4% cardiovascular-renal complications; and 34.9% insulin treated). After a mean (SD) follow-up period of 414 (55) days, 5 patients had died, 144 had at least 1 hospitalization, and 586 had repeated comprehensive assessments. On intention-to-treat analysis, both groups had similar reductions in HbA_{1c} (JADE + PEARL, 0.30% [95% CI, 0.12%-0.47%], vs JADE, 0.29% [95% CI, 0.12%-0.47%] [P = .97]) and improvements in treatment targets and psychological-behavioral measures. In the JADE + PEARL group, 90% of patients maintained contacts with their peer supporters, with a median of 20 calls per patient. Most of the discussion items were related to self-management.

CONCLUSIONS AND RELEVANCE In patients with T2DM receiving integrated care, peer support did not improve cardiometabolic risks or psychological well-being.

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Diabetes and its complications are preventable, although there are significant gaps in care goals.[1,2] Experts have recommended using a multicomponent strategy including redesign of workflow, knowledge transfer, information technology, and quality measures to improve diabetes and long-term care.[3,4] In a meta-analysis of quality improvement initiatives, team restructuring, case management, and patient education had the greatest effect size in reducing hemoglobin A_{1c} (HbA_{1c}), blood pressure (BP), and low-density lipoprotein cholesterol (LDL-C) levels.[5] In clinical trials, the use of protocols, nurses, and monitors was associated with considerably lower clinical event rates than that reported in epidemiological surveys.[6] In line with the long-term care model,[7] our group has reported the benefits of using team management and protocols with predefined processes and treatment targets, regular feedback, and decision support on clinical outcomes.[8-10] However, psychological distress[11] and suboptimal self-management remain significant challenges in real-world practice.[12] In a meta-analysis, duration of contact time was the main predictor for reduced HbA_{1c} level,[13] although the average medical consultation time was only 6 minutes.[14] In this context, peer supporters might fill this gap by providing support for daily management, linkage to clinical care, and ongoing social and emotional support.[15]

The publicly funded Hospital Authority of Hong Kong governs all public hospitals and clinics to provide the bulk of long-term care. In 1995, the Hospital Authority established a territory-wide electronic Clinical Management System, which uses *International Classification of Diseases, Ninth Revision,* to capture all hospital discharge diagnoses. Since 1995, we have established a Hong Kong Diabetes Registry that includes a twice-weekly nurse-coordinated quality improvement program using standard protocols.[16] In 2007, we developed the Joint Asia Diabetes Evaluation (JADE) Program to deliver integrated care by incorporating care protocols[8-10] into a web-based portal to stratify risk with personalized reports and decision support to promote informed decisions.[17,18]

By reorganizing the workflow and using the web-based JADE (Joint Asia Diabetes Evaluation) portal to provide integrated care, we aim to reduce clinical inertia and nonadherence to improve cardiometabolic risk. In these patients receiving integrated care, we hypothesized that added frequent contacts through a telephone-based peer support (PEARL [Peer Support, Empowerment, and Remote Communication Linked by Information Technology]) program can improve self-management and psychological well-being to improve cardiometabolic risk factors (**Figure 1**).

Methods

This study was approved by the Joint Chinese University of Hong Kong Hospital Authority New Territories East Cluster Clinical Research Ethics Committee. All patients provided written informed consent. The trial flow is shown in Figure 1. Of 3714 participants, 628 were randomized after 3086 were excluded (312 to JADE + PEARL and 316 to JADE only) (**Figure 2**).

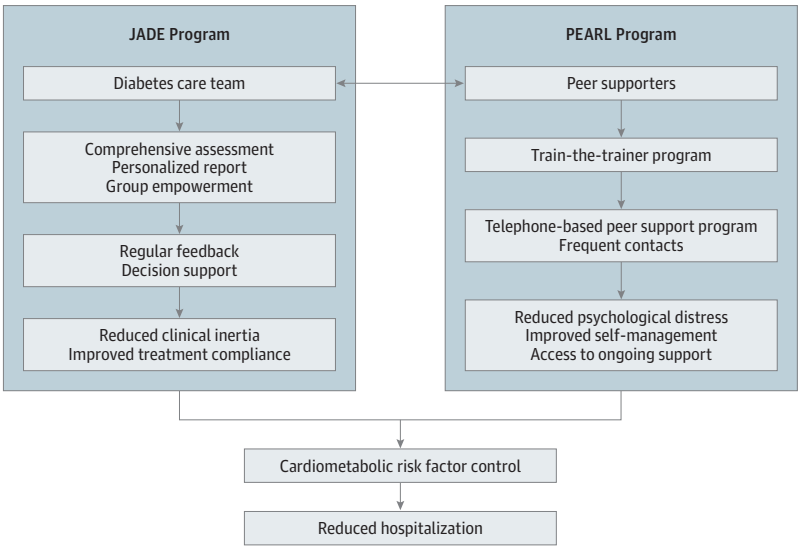
The JADE Program

The study was conducted in 3 diabetes centers that provide twice-weekly structured comprehensive assessments[3] implemented through the JADE portal (refer to video at http://www.idfce-hk.org). Using these clinical and biochemical results, the JADE portal generated 1 of 4 risk categories based on different combinations of cardiovascular-renal complications, chronic kidney disease (CKD) (defined as estimated glomerular filtration rate [eGFR] less than 60 mL/min/1.73m^2), risk scores for cardiovascular-renal disease,[19-22] and number of risk factors (see eAppendix in Supplement). These 4 risk categories had been internally validated with 5-year probabilities of all events at 38%, 18%, 12%, and 5% respectively.[17] The personalized report displayed the risk category, 5-year probabilities of individual clinical event in bar charts, and trend lines of attained and recommended target values of HbA_{1c}, BP, LDL-C, and body weight. These target values triggered reminders on medication adherence, self-monitoring, weight control, diet, and physical activity for patients and periodic assessments, individualized goals, and treatment intensification for physicians.[18] All patients received their reports 4 to 6 weeks later during a 2-hour nurse-led group empowerment class with reinforcement on self-care and attainment of multiple treatment targets. All patients were followed up in their usual clinics every 3 to 4 months, when most physicians ordered HbA_{1c} measurement and recorded BP and bodyweight, in accordance with international guidelines. However, as in most public health care institutions, different physicians reviewed these patients with short consultation time. In this project, we enhanced the care by using a research assistant to retrieve the appointment dates, laboratory results, and clinic measurements from the Clinical Management System. The available data were entered into the JADE portal to generate follow-up reports, which were mailed to the patients with a cover letter, encouraging them to discuss their progress with their care team as appropriate.

The "Train-the-Trainer" Program

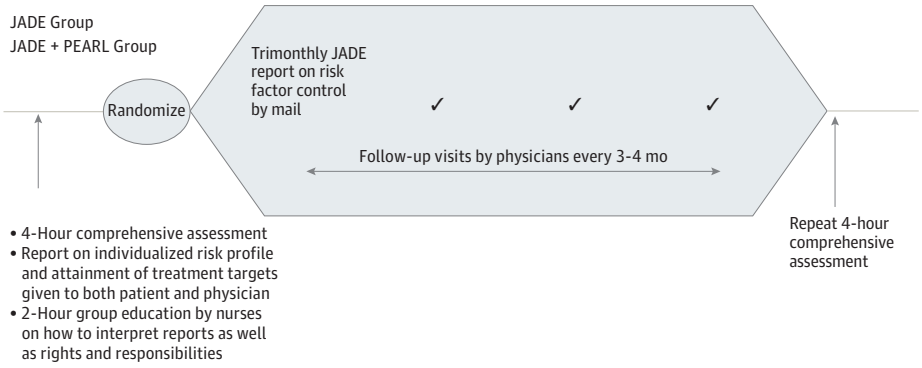
Our diabetes nurses first invited 79 motivated patients with HbA_{1c} levels lower than 8% to attend a "Train-the-Trainer" program consisting of four 8-hour workshops, each attended by 30 to 35 patients. The training program was designed by health care professionals and behavioral scientists and run by neurolinguistic consultants, sports scientists, psychologists, nurses, and physicians. The training format included tutorials, case sharing, reflections, role playing, games, and activities with peer supporters receiving tutorial notes and reference materials. Throughout these sessions, they were reinforced on the principles of communication and empathic listening and encouraged to share their positive experiences to assist their peers to manage diabetes on a day-to-day basis. The peer supporters were reminded of factors that could influence blood glucose level, eg, diet, exercise, poor sleep, stress, changes in daily routines, body weight, medications, and concurrent illnesses, and thus the importance of self-monitoring of blood glucose. Some of them were active members of patient groups organized by lay associations or diabetes centers. All participants underwent a before and after evaluation of diabetes knowledge and psychological-behavioral measures.

Figure 1. Conceptual Framework and Study Design



JADE + PEARL Group

Month	0	1	2	3	4	5	6	7	8	9	10	11	12
Nurse-led introductory group meeting between peer and peer supporters	✓												
Telephone calls by peer supporters		✓✓	✓✓	✓✓	✓	✓	✓		✓		✓		✓



- 4-Hour comprehensive assessment
- Report on individualized risk profile and attainment of treatment targets given to both patient and physician
- 2-Hour group education by nurses on how to interpret reports as well as rights and responsibilities

The conceptual framework and study design to evaluate the effects of providing frequent support through a telephone-based peer support program (PEARL [Peer Support, Empowerment, and Remote Communication Linked by Information Technology]) to reduce cardiometabolic risk and hospitalization rates by improving psychological well-being and self-management in patients with type 2 diabetes mellitus receiving integrated care implemented through a web-based multicomponent quality improvement program (JADE [Joint Asia Diabetes Evaluation]) with risk stratification, personalized reports, regular feedback, and decision support.

The PEARL Program

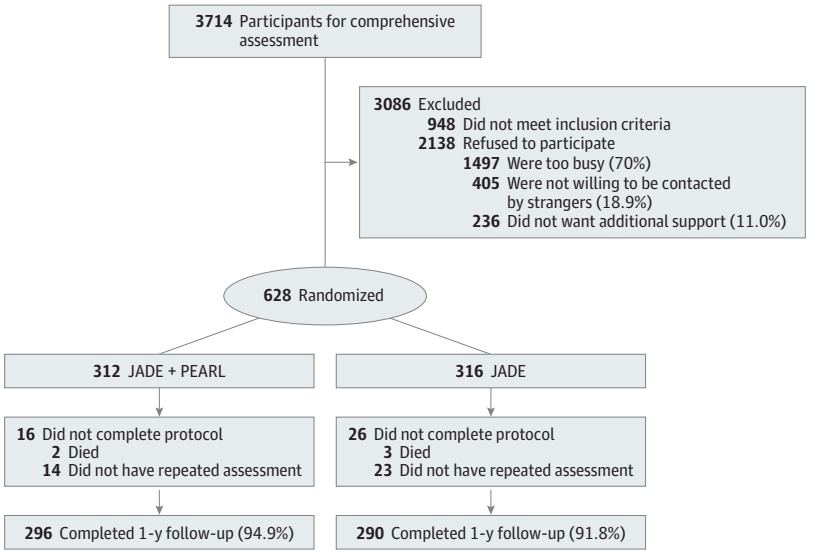
Inclusion and Exclusion Criteria

All Chinese patients with type 2 diabetes mellitus (T2DM) aged 18 to 70 years who underwent comprehensive assessments and expressed willingness to participate were eligible. Exclusion criteria included illiteracy, inability to communicate in Chinese, and JADE Risk Category 1 (no complication, ≤1 risk factor, and low-risk score) (see eAppendix in Supplement). Because these peer supporters had not been trained on how to handle psychotic symptoms, thought disorders, and suicidal ideas, patients requiring psychiatric treatment were also excluded.

Study Design, Implementation, and Randomization

The study was funded by the American Academy for Family Physicians Foundation, which competitively reviewed the full proposal. Predefined primary, secondary, and other outcome measures were included in this review. Eligible patients were invited to participate in the program after they received their personalized report during the group empowerment class at the diabetes centers. None of the peer supporters attended these sessions. After giving written informed consent, the participants completed additional questionnaires to assess psychological distress, medication adherence, and self-care. The project was administered by the office of the Asia Diabetes Foundation, which prepared consecutively numbered, opaque, and sealed envelopes containing computer-generated random numbers, which were sent to each of the 3 centers in blocks of 100, with 1:1 ratio of assignment. At the center, the envelope was opened by a non-nursing staff not involved in the study.

Figure 2. Trial Flow Diagram



Randomization, retention, and outcomes of 628 patients with type 2 diabetes mellitus receiving integrated care through the JADE program randomized to receive either peer support (JADE + PEARL group) or no peer support (JADE group). JADE indicates Joint Asia Diabetes Evaluation; PEARL, Peer Support, Empowerment, and Remote Communication Linked by Information Technology.

Intervention by Peer Supporters

Of the 59 patients who completed the course, 33 agreed to become peer supporters and attended an additional 3-hour briefing session on the rationale, objectives, and protocol of the study, led by the project team. Of these 33 peer supporters, 35% were male and the mean (SD) age, disease duration, and HbA_{1c} level were 55.6 (11.5) years, 11.03 (6.71) years, and 7.25% (1.27%), resepectively; 9 were treated with insulin. Among them, 29 had secondary school or higher education, 7 of whom had tertiary education. The majority of them were retired managers or skilled or nonmanual workers. During this briefing session, they were reminded of their non-health care professional status and to advise their peers to seek medical advice for uncertain issues. They were asked to keep sensitive information confidential for sharing only with the medical team. All peer supporters were given a booklet on resources (eg, websites and telephone numbers of community centers, lay associations, and hospital diabetes centers and titles of self-help books) and a 3-monthly checklist to document the discussion items (diet, exercise, self-monitoring of blood glucose, sick day management, foot care, emotional support, resources for information, and clinical care), duration of each call, and relevant remarks. The peer supporters were asked to mail the completed checklist to the Asia Diabetes Foundation project coordinator, who entered the data and sent new checklists and stipend to the peer supporters. The physicians, nurses, and project coordinators met all peer supporters on 3 occasions for a half-day meeting to facilitate experience sharing, mutual support, and problem shooting.

Introduction of Peer Supporters to Peers by Nurses

For patients assigned to the JADE + PEARL group, the nurses put them in groups of 10 and arranged a separate 2-hour session when 2 to 3 groups of patients were introduced to their assigned peer supporters, each of whom was assigned 10 patients. None of the peer supporters were aware of the details of the control group. During these weekend sessions, the nurses facilitated group sharing on self-care and stress management. After exchanging telephone numbers, the peer supporters were instructed to call their assigned peers at least 12 times—initially, biweekly calls for 3 months, then monthly calls for 3 months, and then 1 call every other month for 6 months, with an anticipated 15 minutes per call. Both peer supporters and peers were encouraged to call one another ad lib (Figure 1). In Hong Kong, the median monthly income was US $1800 (approximately US $10 per hour). Together with 15 minutes of documentation, we estimated that each peer supporter would spend 60 hours calling their assigned 10 peers. All peer supporters were happy to volunteer but we decided to offer them US $500 (80% of hourly rate) as a small stipend.

Main Outcomes and Measures

The primary outcome was change in HbA_{1c} level and the secondary outcome was the proportion of patients with attained ABC goals (HbA_{1c} <7.0%; BP <130/80 mm Hg; LDL-C level <2.6 mmol/L [to convert to milligrams per deciliter, divide by 0.0259]). Other outcomes included psychological-behavioral measures using validated instruments in the Chinese language at 12 months. The latter included EQ-5D (5-item Euroqol for quality of life),[23] PHQ-9 (9-item Patient Health Questionnaire for depression),[24] DASS-21 (21-item Depression Anxiety Stress Scale for psychological distress),[25] DES-20 (20-item Diabetes Empowerment Scale for self-efficacy),[26] and CDDS-15 (Chinese 15-item Diabetes Distress Scale).[27] We translated the SDSCA1-14 (14-item Summary for Diabetes Self-care Activities)[28] and a 4-item questionnaire[29] to assess self-care and medication adherence, respectively. We used Chinese-validated cutoff points to define psychological distress (PHQ-9 score ≥7,[30] DASS-21 score ≥17,[28] and CDDS-15 score ≥45[27]) (**Table 1**).

Table 1. Baseline Characteristics of Patients

Variable	Nonparticipants (1 of 3 Centers) (n = 1514)	Participants (n = 628)	*P* Value	JADE + PEARL (n = 312)	JADE (n = 316)	*P* Value
Demographics						
Age, mean (SD), y	55.5 (9.7)	54.7 (9.3)	.07	54.5 (9.9)	54.8 (8.6)	.67
Men, No. (%)	755 (49.9)	355 (56.5)	.005	178 (57.1)	177 (56.0)	.79
Disease duration, mean (SD), y	9.6 (7.6)	9.4 (7.7)	.59	9.2 (7.8)	9.6 (7.7)	.58
Employed (full-time or part-time), No. (%)	678 (44.8)	303 (48.3)	.14	145 (46.5)	158 (50.0)	.32
Manual worker among those employed, No. (%)	263 (17.5)	83 (13.2)	.01	35 (23.5)	48 (30.6)	.20
Education, No. (%)						
<6 y	674 (44.7)	228 (36.3)	.002	109 (34.9)	119 (37.7)	.34
6-11 y	639 (42.3)	309 (49.2)		154 (49.4)	155 (49.1)	
>11 y	196 (13.0)	91 (14.5)		49 (15.7)	42 (13.3)	
Tobacco use (current or former), No. (%)	463 (30.6)	219 (34.9)	.052	104 (33.3)	115 (36.4)	.39
Alcohol use (regular or occasional), No. (%)	488 (32.2)	206 (32.9)	.78	103 (33.1)	103 (32.6)	.89
Complications and comorbidities, No. (%)						
Chronic kidney disease	104 (6 .9)	46 (7.4)	.69	23 (7.5)	23 (7.3)	.94
Retinopathy	421 (27.8)	222 (35.4)	.001	116 (37.2)	106 (33.5)	.34
Sensory neuropathy	76 (5.0)	40 (6.4)	.21	25 (8.0)	15 (4.7)	.09
All heart events	108 (7.1)	67 (10.7)	.006	33 (10.6)	34 (10.8)	.92
Cardiovascular-renal complications	210 (13.9)	109 (17.4)	.04	54 (17.3)	55 (17.4)	.95
Risk categories, No. (%)[a]						
Very high	210 (13.9)	109 (17.4)	<.001	54 (17.3)	55 (17.4)	.68
High	11 127 (74.4)	489 (77.9)		240 (76.9)	249 (78.8)	
Medium	57 (10.4)	28 (4.5)		18 (5.8)	10 (3.2)	
Low	20 (1.3)	2 (0.3)		0	2 (0.6)	
Treatment for diabetes, No. (%)						
Lifestyle modification only	119 (7.9)	56 (8.9)	<.001	28 (9.0)	28 (8.9)	.16
Oral drugs only	1034 (68.3)	353 (56.2)		166 (53.2)	187 (59.2)	
Insulin only	102 (6.7)	38 (6.1)		25 (8.0)	13 (4.1)	
Oral drugs and insulin	25 (17.1)	181 (28.8)		93 (29.7)	88 (27.9)	
Treatment for other risk factors, No. (%)						
BP-lowering drugs	843 (55.7)	409 (65.1)	<.001	199 (63.8)	210 (66.5)	.48
ACE inhibitors	588 (38.8)	292 (46.5)	.001	147 (47.1)	145 (45.9)	.76
Angiotensin II receptor blockers	89 (5.9)	55 (8.8)	.02	22 (7.1)	33 (10.4)	.13
Lipid-regulating drugs	631 (41.7)	278 (44.3)	.27	142 (45.5)	136 (43.0)	.53
Statins	554 (36.6)	249 (39.6)	.18	125 (40.1)	124 (39.2)	.88
Risk factor control						
BMI, mean (SD)	26.1 (4.4)	26.9 (4.5)	<.001	26.6 (4.3)	27.1 (4.6)	.17
Systolic BP, mean (SD), mm Hg	137 (19)	136 (19)	.42	136 (19)	135 (19)	.70
Diastolic BP, mean (SD), mm Hg	80 (11)	80 (11)	.48	80 (10)	80 (11)	.94
HbA_{1c}, mean (SD), %	7.5 (1.4)	8.2 (1.6)	<.001	8.2 (1.7)	8.2 (1.6)	.89
HDL-C, mean (SD), mmol/L	1.30 (0.38)	1.21 (0.36)	<.001	1.21 (0.35)	1.20 (0.36)	.72
LDL-C, mean (SD), mmol/L	2.83 (0.84)	2.89 (0.82)	.15	2.90 (0.81)	2.87 (0.82)	.59
Total cholesterol, mean (SD), mmol/L	4.80 (0.97)	4.87 (1.07)	.20	4.86 (0.98)	4.87 (1.15)	.99
Triglycerides, median (IQR), mmol/L	1.28 (0.90-1.80)	1.40 (1.00-2.00)	<.001	1.40 (1.00-2.00)	1.40 (1.00-2.00)	.85
General obesity, No. (%)	478 (31.6)	245 (39.1)	.001	110 (35.3)	135 (43.0)	.047

(continued)

Table 1. Baseline Characteristics of Patients (continued)

Variable	Nonparticipants (1 of 3 Centers) (n = 1514)	Participants (n = 628)	*P* Value	JADE + PEARL (n = 312)	JADE (n = 316)	*P* Value
Central obesity, No. (%)	980 (64.7)	443 (71.0)	.005	212 (67.9)	231 (74.0)	.09
Hypertension, No. (%)	1226 (81.0)	528 (84.1)	.09	257 (82.1)	271 (86.0)	.18
Dyslipidemia, No. (%)	1343 (88.9)	588 (93.8)	.001	289 (92.3)	299 (95.2)	.13
Urinary sport ACR, median (IQR), mg/mmol	1.5 (0.6-5.8)	2.0 (0.7-10.2)	.004	2.0 (0.8-10.2)	2.0 (0.6-10.4)	.52
eGFR, median (IQR), mL/min/1.73 m^2	109 (90-126)	109 (80-129)	.46	110 (91-128)	106 (88-129)	.53
Microalbuminuria, No. (%)	341 (23.3)	166 (26.8)	.09	78 (25.5)	88 (28.1)	.46
Macroalbuminuria, No. (%)	194 (13.3)	106 (17.1)	.02	59 (19.3)	47 (15.0)	.16
Attainment of treatment targets, No. (%)						
HbA_{1c} <7%	626 (41.4)	143 (22.8)	<.001	73 (23.4)	70 (22.2)	.71
BP <130/80 mm Hg	477 (31.5)	195 (31.1)	.84	94 (30.1)	101 (32.0)	.62
LDL-C <2.6 mmol/L	594 (39.7)	226 (36.5)	.18	118 (38.2)	108 (34.8)	.39
At least 1 target	1135 (75.4)	407 (65.4)	.001	204 (65.8)	203 (65.1)	.85
At least 2 targets	481 (31.9)	142 (22.7)	<.001	76 (24.4)	66 (21.0)	.30
All 3 targets	81 (5.4)	15 (2.4)	.003	5 (1.6)	10 (3.2)	.20
Psychological-behavioral parameters	NA	NA	NA			
PHQ-9, mean (SD), score	NA	NA	NA	4.3 (4.2)	4.1 (4.1)	.47
PHQ-9 score ≥7, No. (%)	NA	NA	NA	64 (20.5)	71 (22.6)	.52
DASS-21 (negative emotions), median (IQR), score	NA	NA	NA	7 (0-14)	7 (0-15)	.94
DASS-21 score ≥17, No. (%)	NA	NA	NA	58 (18.6)	66 (20.9)	.48
CDDS-15 (diabetes distress), mean (SD), score	NA	NA	NA	43.1 (15.0)	41.2 (14.6)	.28
CDDS-15 score ≥45, No. (%)	NA	NA	NA	133 (42.8)	127 (40.3)	.53
DES-20 (self-efficacy), mean (SD), score	NA	NA	NA	76.9 (8.2)	76.0 (8.1)	.17
SDSCA-14 (self-care activities), mean (SD), score	NA	NA	NA	48.7 (17.6)	48.6 (17.5)	.99
EQ-5D index (quality of life), mean (SD), score	NA	NA	NA	0.91 (0.15)	0.90 (0.19)	.30
Medication adherence, No. (%)						
Adherence						
High	NA	NA	NA	128 (43.1)	137 (46.3)	.36
Intermediate	NA	NA	NA	150 (50.5)	144 (48.6)	
Low	NA	NA	NA	19 (6.4)	15 (5.1)	
Forgot and/or careless about medications, No. (%)	NA	NA	NA	180 (58.3)	178 (57.6)	.87

Abbreviations: ACE, angiotensin-converting enzyme; ACR, albumin to creatinine ratio; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); BP, blood pressure; CDDS-15, 15-item Chinese Diabetes Distress Scale; DASS-21, 21-item Depression Anxiety Stress Scale; DES-20, 20-item Diabetes Empowerment Scale; eGFR, estimated glomerular filtration rate; EQ-5D, 5-item Euroqol; HbA_{1c}, hemoglobin A_{1c}; HDL-C, high-density lipoprotein cholesterol; IQR, interquartile range; JADE, Joint Asia Diabetes Evaluation; LDL-C, low-density lipoprotein cholesterol; NA, no psychological assessment; PEARL, Peer Support, Empowerment, and Remote Communication Linked by Information Technology; PHQ-9, 9-item Patient Health Questionnaire; SDSCA-14, 14-item Summary of Diabetes Self-care Assessment.

Conventional conversion factors: To convert cholesterol and triglycerides to milligrams per deciliter, divide by 0.0259 and 0.0113, respectively.

[a] See eAppendix in Supplement for definitions of risk categories, complications, and risk parameters and score ranges for assessment tools.

Sample Size and Statistical Analysis

With an HbA_{1c} level reduction of 0.5% as a surrogate marker for long-term clinical benefits, with 1.7% standard deviation, 250 patients in each arm gave 90% power at an α level of .05 to confirm the benefits of peer support on glycemic control. We recruited more than 600 patients, assuming a 10% attrition rate. All data were analyzed by personnel not involved in the intervention program (Y.S., Y.Z, and W.G.). We applied intention-to-treat analysis to all randomized patients using SPSS version 20.0 (SPSS Inc, an IBM company) and SAS release 9.30 (SAS Institute Inc) statistical software. All data are expressed as mean (SD) or median (interquartile range [IQR]), as appropriate. For patients who defaulted reassessment at 1 year, we retrieved their laboratory results within 3 months of the due date from the Clinical Management System, if available. The Pearson χ^2 test, Fisher exact test, *t* test, Wilcoxon paired test,

Table 2. Changes in Cardiometabolic Risk Factors and Psychological-Behavioral Measures in Patients With Type 2 Diabetes Mellitus After Receiving 1 Year of Integrated Care With Peer Support (JADE + PEARL) or Integrated Care Only (JADE)[a]

Cardiometabolic Risk Factor/Psychological-Behavioral Measure	Change Compared With Baseline		P Value
	JADE + PEARL (n = 296)	JADE (n = 290)	
HbA_{1c}, %[b]	−0.30 (−0.47 to −0.12)	−0.29 (−0.47 to −0.12)	.97
BP, mm Hg			
Systolic	−3.17 (−5.14 to −1.20)	−2.72 (−4.86 to −0.59)	.76
Diastolic	−3.58 (−4.78 to −2.38)	−3.84 (−5.04 to −2.65)	.76
Body weight, kg	−0.28 (−0.68 to 0.12)	0.00 (−0.48 to 0.47)	.38
BMI	−0.09 (−0.25 to 0.06)	0.01 (−0.18 to 0.21)	.41
Waist, cm			
Men	1.24 (0.50 to 1.98)	1.51 (0.78 to 2.24)	.61
Women	1.44 (0.53 to 2.34)	1.05 (0.06 to 2.04)	.57
Total cholesterol, mmol/L	−0.24 (−0.35 to −0.13)	−0.27 (−0.40 to −0.14)	.73
HDL-C, mmol/L	0.08 (−0.04 to 0.11)	0.07 (−0.04 to 0.09)	.67
LDL-C, mmol/L	0.29 (0.20 to 0.39)	0.26 (0.16 to 0.36)	.65
Triglycerides, mmol/L	−0.05 (−0.18 to 0.07)	−0.25 (−0.45 to −0.04)	.11
eGFR, mL/min/1.73 m^2	−6.09 (−7.77 to −4.41)	−4.90 (−7.33 to −2.47)	.43
Urinary ACR, mg/mmol	−14.74 (−24.82 to −4.66)	−14.57 (−23.31 to −5.83)	.98
Addition of insulin, No. (%)	24 (8.1)	33 (11.4)	.18
Addition of lipid-regulating drugs, No. (%)	41 (13.8)	55 (19.0)	.09
Addition of RAS inhibitors, No. (%)	37 (12.5)	30 (10.3)	.72
PHQ-9 score	0 (−0.42 to 0.41)	0.01 (−0.46 to 0.49)	.96
DASS-21 score	−1.47 (−2.67 to −0.27)	−0.64 (−1.88 to 0.61)	.34
CDDS-15 score	−2.56 (−4.27 to −0.86)	−2.1 (−3.84 to −0.37)	.71
DES-20 score	1.35 (0.24 to 2.45)	1.24 (0.06 to 2.42)	.90
SDSCA-14 score	4.09 (2.11 to 6.07)	4.56 (2.62 to 6.50)	.74
EQ-5D score	−0.01 (−0.28 to 0.22)	0.00 (−0.28 to 0.33)	.68
Medication adherence score	−0.17 (−0.30 to −0.04)	−0.03 (−0.15 to 0.09)	.11
Forgot and/or careless about medications, No. (%)	87 (28.2)	78 (25.2)	.41

Abbreviations: ACR, albumin to creatinine ratio; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); BP, blood pressure; CDDS-15, 15-item Chinese Diabetes Distress Scale; DASS-21, 21-item Depression Anxiety Stress Scale; DES-20, 20-item Diabetes Empowerment Scale; eGFR, estimated glomerular filtration rate; EQ-5D, 5-item Euroqol; HbA_{1c}, hemoglobin A_{1c}; HDL-C, high-density lipoprotein cholesterol; JADE, Joint Asia Diabetes Evaluation; LDL-C, low-density lipoprotein cholesterol; PEARL, Peer Support, Empowerment, and Remote Communication Linked by Information Technology; PHQ-9, 9-item Patient Health Questionnaire; RAS, renin-angiotensin system; SDSCA-14, 14-item Summary of Diabetes Self-care Assessment.

Conventional conversion factors: To convert cholesterol and triglycerides to milligrams per deciliter, divide by 0.0259 and 0.0113, respectively.

[a] Data are given as mean (95% CI) unless otherwise specified.

[b] For patients who did not return for repeated comprehensive assessment at 1 year, HbA_{1c} values within 3 months of the due date for assessment were retrieved from the Clinical Management System.

and Mann-Whitney test were used for group comparisons, as appropriate. For each patient, we censored the hospitalization data at 1 year or date of reassessment. For hospitalization data, we used zero-inflated negative binomial regression with adjustment for age, sex, disease duration, and risk category. $P < .05$ (2-tailed) was considered significant.

Results

Between 2009 and 2010, 628 of 2766 eligible patients who underwent comprehensive assessment agreed to participate. The reasons of refusal included being too busy (70.0%), not wanting to be contacted by strangers (18.9%), or not wanting additional support (11.0%). Participants were more likely to be men with higher education but also with higher rates of complications, risk factors, and use of multiple medications. Using Chinese-validated cutoff points, 20% to 40% of participants had emotional distress based on several pertinent measures, and 50% admitted to being forgetful or careless about their medications (Table 1).

After a mean (SD) follow-up of 414 (55) days, 144 had at least 1 hospitalization and 31 developed cancer, cardiovascular-renal complications, or died, with similar event rates between groups. Two patients died in the JADE + PEARL group (1 with asthma and 1 with vocal cord leukoplakia) and 3 in the JADE group (1 with stroke, 1 with atrial fibrillation, and 1 with peripheral vascular disease). At 1 year, 586 had repeated assessments (Figure 2). In the intention-to-treat analysis, HbA_{1c} level was reduced by 0.3% in both groups. Both groups had similar proportions with improved treatment targets (1 target, 65.8%-81.0% [JADE + PEARL] vs 65.1%-81.0% [JADE]; 2 targets, 24.4%-32.5% [JADE + PEARL] vs 21.0%-37.0% [JADE]; 3 targets, 1.6%-5.6% [JADE + PEARL] vs 3.2%-6.8% [JADE] [$P < .001$ within group; nonsignificant between groups]), and 10% to 20% of patients had their treatments intensified (**Table 2**). Both groups also improved similarly and significantly in most psychological-behavioral parameters including medication adherence and self-efficacy (Table 2). During the study period, 26% in the JADE group and 20% in the JADE + PEARL group were hospitalized at least once, 40% of which were due to cardiovascular-renal events. Hospitalized

Table 3. Comparisons of Hospitalization Rates Between Patients With Type 2 Diabetes Mellitus Receiving Integrated Care Randomized to Peer Support (JADE+PEARL) or Without (JADE) After 1 Year of Intervention, Further Stratified by DASS-21 Score

Variable	Total (n = 628)		DASS-21 Score ≥17 (n = 124)		DASS-21 Score <17 (n = 503)	
	JADE + PEARL (n = 312)	JADE (n = 316)	JADE + PEARL (n = 58)	JADE (n = 66)	JADE + PEARL (n = 253)	JADE (n = 250)
Follow-up duration, mean (SD), d	437 (51)	404 (53)	443 (62)	406 (59)	435 (49)	404 (51)
No. of hospitalization admissions, No. (%)						
0	249 (79.8)	235 (74.4)	48 (82.8)	34 (51.5)	200 (79.1)	201 (80.4)
1	46 (14.7)	44 (13.9)	8 (13.8)	19 (28.8)	38 (15.0)	25 (10.0)
2	8 (2.6)	17 (5.4)	0	5 (7.6)	8 (3.2)	12 (4.8)
≥3	9 (2.9)	20 (6.3)	2 (3.4)	8 (12.1)	7 (2.8)	12 (4.8)
Total length of stay, No. (%)						
1-2 d	37 (11.9)	46 (14.6)	5 (8.6)	20 (30.3)	32 (12.6)	26 (10.4)
3-5 d	9 (2.9)	11 (3.5)	1 (1.7)	4 (6.1)	8 (3.2)	7 (2.8)
6-10 d	6 (1.9)	13 (4.1)	1 (1.7)	4 (6.1)	5 (2.0)	9 (3.6)
≥11 d	11 (3.5)	11 (3.5)	3 (5.2)	4 (6.1)	8 (3.2)	7 (2.8)

Abbreviations: DASS-21, 21-item Depression Anxiety Stress Scale; JADE, Joint Asia Diabetes Evaluation; PEARL, Peer Support, Empowerment, and Remote Communication Linked by Information Technology.

patients were older and had multiple complications, treatments, and negative emotions. The JADE + PEARL group had fewer rehospitalizations (≥2 admissions) than the JADE group (5.5% vs 11.7%), mainly because of short stays of less than 10 days (16.7% vs 22.2%) (**Table 3**).

Post Hoc Analysis

In light of lower rehospitalization rates, mainly due to short stays in the JADE + PEARL group and according to our conceptual framework (Figure 1), we hypothesized that frequent contacts through peer support might improve self-management and psychological distress with reduced hospitalizations. Because peer support has been reported to reduce depressive symptoms[31] and chronic disease self-management might reduce rehospitalization rates,[32] we conducted an exploratory analysis to examine possible interactions between peer support and emotional distress on hospitalization rates. We stratified patients by DASS-21, CDDS-15, and PHQ-9 scores and found associations with hospitalization only with DASS-21. When a DASS-21 score of 17 or higher was used as an indicator, 124 patients (19.7%) had elevated levels of distress, who were more obese and had lower medication adherence than those without distress. In these patients, peer support improved DASS-21 score (mean change [95% CI], 11.93 [1.07 to 16.79] vs 5.88 [2.00 to 9.76] [P = .03]) and medication adherence score (mean change [95% CI], 0.53 [0.17 to 0.88] vs −0.06 [−0.33 to 0.22] [P = .009]). Patients with elevated levels of distress were more likely to be hospitalized (42 of 124 [34%]) than those without (102 of 503 [20%]). In these patients, JADE + PEARL reduced hospitalizations with relative risks of 0.15 (95% CI, 0.07-0.34) (P < .001) for hospitalization rates and 0.16 (95% CI, 0.05-0.56) (P = .004) for day admissions relative to the PEARL group. In the nondistressed group, peer support did not have any effect on hospitalization rates.

Adoption and Satisfaction With the PEARL Program

Two peer supporters withdrew from the program and their assigned patients were transferred to other peer supporters. In the JADE + PEARL group, 279 patients (90%) maintained contacts with their peer supporters (5227 calls in total; median [interquartile range] calls per patient, 20 [9-24]). Diet (17.6%), exercise (15.6%), self-monitoring of blood glucose (15.5%), self-care (13.1%), and medication use (11.4%) were the most popular discussion items.

Discussion

In this 1-year study, peer support did not improve cardiometabolic and psychological well-being in patients with T2DM receiving integrated care. In an exploratory analysis, patients with negative emotions appeared to benefit from additional peer support with better treatment compliance, improved psychological health, and reduced hospitalizations. However, these interactions were not a priori outcomes of the trial and must be interpreted with caution.

In a 6-month study, peer support reduced HbA_{1c} level by 0.77% compared with usual care in 300 patients with T2DM with a mean HbA_{1c} level of 10% at baseline.[33] In another 6-month study involving 244 patients with diabetes, mean HbA_{1c} level decreased from 8.02% to 7.73% in the peer support group and increased from 7.93% to 8.22% in the control group.[34] In the present cohort with a mean HbA_{1c} level of 8.2%, integrated care reduced HbA_{1c} level by 0.3% in both groups, with a 50% reduction in medication nonadherence rate, and 8% to 10% of patients had their treatments intensified. These patients also had less emotional distress with better self-efficacy and self-care, suggesting that reorganizing care and empowering patients with personalized information could result in clinical benefits. Adding peer support to this reorgani-

zation of care, however, did not further improve cardiometabolic or psychological health.

It is noteworthy that hospitalization rate was lower in the JADE + PEARL group despite lack of improvement in cardiometabolic risks and psychological health. In a 6-month study, patients with multiple morbidities who received coaching on the chronic disease self-management program had better health behavior and health status and spent 0.8 fewer hospital nights compared with the control group.[32] In another 6-month study, chronically ill patients who received a postdischarge telephone intervention had lower readmission rates compared with the control group (23% vs 29%), with a 50% risk reduction after adjustment for clinical diagnoses.[35]

In Hong Kong, private insurance is not mandatory and primary care is largely fee-for-service. Many patients with chronic diseases such as diabetes attended the emergency department for various ailments followed by observations in short-stay wards before discharge or triage to long-stay wards. In this hospital-clinic based population, 17% had cardiovascular-renal complications and 80% of hospitalized patients had comorbidities with high levels of emotional distress. During the study period, 20% in the JADE + PEARL group and 26% in the JADE group required at least 1 admission, which might be due to the lack of community support or access to regular family physicians. Whether peer support might reduce hospitalization, especially in vulnerable patients with comorbidities and emotional distress, requires further study.

In an exploratory analysis, we observed benefits of peer support in the 20% of patients with elevated levels of emotional distress (DASS-21 score ≥17). In these patients, the hospitalization rate was 48% in the JADE and 17% in the JADE + PEARL groups. In these distressed patients with high rates of nonadherence and hospitalizations (data not shown), peer support reduced nonadherence and negative emotions, which might have contributed to the lower hospitalization rates. Other researchers had reported greater benefits of peer support on HbA_{1c} level in the patients with T2DM with poor treatment compliance.[36] In a 6-month study, patients with depression who received 10 telephone calls, with a mean duration of 26 minutes, had reduced depressive symptoms compared with the control group.[31] Among US Medicaid enrollees, lack of regular care, low levels of family and social support, and mental illness were associated with frequent hospitalizations.[37] In a subsequent integrated postdischarge care program with data sharing and communication among team members, hospitalizations were reduced by 37.5%, with a cost reduction of US $16 383 per patient over 12 months.[38] In patients receiving integrated care with empowerment and decision support, peer support may confer additional benefits only in high-risk patients such as those with comorbidities, noncompliance, emotional distress, and associated disproportionate hospital and emergency care.

We used validated methods to evaluate pragmatic and multidimensional approaches to improve quality of care.[39] In this multicomponent project that builds on 2 decades of quality improvement initiatives, we have rigorously tested the added effects of peer support in patients with T2DM receiving integrated care and found that peer support did not improve cardiometabolic risks or psychological health. While our exploratory analysis suggested that patients with psychological distress may benefit most from peer support, these results will need external replication. There are ongoing peer support activities in the participating centers, but none of them had structured programs as described herein. Peer supporters were not aware of the control group, making contamination unlikely.

Conclusions

In patients with T2DM receiving integrated care through a web-based multicomponent quality improvement program, peer support did not improve cardiometabolic control and psychological well-being. Whether such peer support could benefit high-risk patients with emotional distress requires further study.

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