



Scaling Up Diabetes Prevention in Victoria, Australia: Policy Development, Implementation, and Evaluation

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OBJECTIVE

The Australian lifestyle intervention program Life! is only the second reported, large-scale diabetes prevention program. This article describes the genesis and the successful establishment of Life! and its key outcomes for participants and implementation.

RESEARCH DESIGN AND METHODS

Life!, a behavior-change intervention, comprises six group sessions over 8 months. The Victorian Department of Health funded Diabetes Australia–Victoria to implement the program. Experience of the Greater Green Triangle diabetes prevention implementation trial was used for intervention design, workforce development, training, and infrastructure. Clinical and anthropometric data from participants, used for program evaluation, were recorded on a central database.

RESULTS

Life! has a statewide workforce of 302 trained facilitators within 137 organizations. Over 29,000 Victorians showed interest in Life!, and 15,000 individuals have been referred to the program. In total, 8,412 participants commenced a Life! program between October 2007 and June 2011, and 37% of the original participants completed the 8-month program. Participants completing sessions 1 to 5 lost an average of 1.4 kg weight ($P < 0.001$) and waist circumference of 2.5 cm ($P < 0.001$). Those completing six sessions lost an average of 2.4 kg weight ($P < 0.001$) and waist circumference of 3.8 cm ($P < 0.001$). The weight loss of 2.4 kg represents 2.7% of participants' starting body weight.

CONCLUSIONS

The impact of Life! is attributable to applying available evidence for the system's design of the intervention and collaboration between policy makers, implementers, and evaluators using the principles of continuous quality improvement to support successful, large-scale recruitment and implementation.

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Type 2 diabetes has been a national health priority in Australia for over a decade. Randomized controlled trials showed that progression to type 2 diabetes in high-risk individuals can be prevented through lifestyle behavior-change programs (1–3). Feasibility of such a program in the Australian setting was tested in the Greater Green Triangle (GGT) Diabetes Prevention Program (DPP) (4). In 2007, the Australian state of Victoria established the first systematic, full-scale type 2 DPP in the world, known as the Life! *Taking Action on Diabetes* program (hereafter referred to as Life!).

Policy Development for Diabetes Prevention

Arguments for a health focus arose from impact on the working population of growing preventable chronic disease prevalence. Concurrently, the national diabetes survey study AusDiab showed that only half of diabetes cases were diagnosed and a quarter of the Australian adult population was at high diabetes risk (5). During 2004–2006, work was undertaken for the Council of Australian Governments (COAG) on a new economic reform agenda to ensure Australia's prosperity in a global market. COAG subsequently announced that the first tranche of human capital reforms would include a specific focus on diabetes (6).

Further in 2006, as part of work undertaken for COAG, the GGT DPP was identified as the only evidence-based diabetes prevention intervention in Australia (7). Combined evidence obtained from the AusDiab study, economic analyses (8), scientific evidence of diabetes prevention effectiveness from randomized controlled trials, and the GGT DPP results strengthened the case for a national policy on diabetes prevention.

Establishing a Statewide Prevention Program in Victoria

In 2007, the Victorian Government approved funding initially until 30 June 2011 for Life!, a large-scale systematic prevention program for high-risk individuals. Scaling up is the process of reaching larger numbers of the target population in a broader geographic area by institutionalizing effective programs. Life! is systematic, with predefined

components interacting as a system. Life! has a direct lineage from the Finnish Diabetes Prevention Study (DPS) (2), Good Ageing in Lahti Region (GOAL) Implementation Trial (9), and GGT DPP (4,10). Additionally, the Department of Health Victoria had experience of its Healthy Living Course DPP (11). Life! is a statewide program, scaled up from randomized controlled and evaluated implementation trials. Little is known about implementing scaled-up DPPs. The first national program was the Finnish national DPP originally implemented as FIN-D2D in 2003 (12,13). Life! is the second scaled-up program reported internationally.

This article describes the genesis, development, and evaluation of Life!, the only *systematic* scaled-up DPP to date. In implementing Life! we aimed to measure real-world versus clinical trial effect sizes and compliance issues with all the real-world constraints, including the lack of Medicare funding (Australian universal health cover) for pathology tests of effect.

RESEARCH DESIGN AND METHODS

Intervention

Life! consists of predefined components interacting as a system. Components include a strictly defined intervention based on the GOAL Implementation Trial, modified according to additional theories of behavioral change (14), the Australian setting, standardized facilitator training and a manual (15,16), payment to facilitators linked to data return to use for performance measurement, continuous quality improvement, and evaluation. Within the continuous quality improvement cycle (17), facilitators receive individualized performance feedback. Furthermore, adapted behavior-change theories such as the Health Action Process Approach model is used to encourage participants to identify the main determinants of intention building and make lifestyle changes associated with healthy diet and active lifestyle, thus reducing their risk of type 2 diabetes and cardiovascular disease (CVD) (14,18).

Life! uses the five Finnish DPS (2) goals:

1. No more than 30% of energy consumed from fat,

2. No more than 10% of energy from saturated fat,
3. At least 15 g fiber/1,000 kcal,
4. At least 30 min/day of moderate-intensity physical exercise, and
5. At least 5% weight reduction.

Each participant is provided with a manual to record their lipid, blood pressure, and blood glucose levels plus their individualized goals and outcomes. Participant manuals cover content of each session, extra reading material, and tasks to do between sessions (e.g., physical activity and diet diaries).

Life! consisted of a group-course six-session intensive intervention for 8–15 people (Fig. 1). In comparison, earlier clinical trials such as the DPS and DPP used individual interventions. The first five sessions occurred every fortnight for 9 weeks. This design is based on the social learning theory (19) that advice and support in the beginning of a lifestyle change process needs to be frequent to provide motivation. The sixth intervention session is scheduled for 8 months after the first session. The objective of session 6 is to follow up with participants and observe maintenance of their newly learned lifestyles (9). Life! is a real-world full-scale prevention program, so it was only feasible to have six sessions, especially since the sessions are group based.

Program Delivery

Diabetes Australia–Victoria, a nongovernmental consumer body and charity representing people affected by diabetes and those at risk, is the lead agency responsible for statewide implementation of Life!. Various advisory committees assisted with development, implementation, and evaluation of Life! (Fig. 2). Program implementation is guided by senior policy officers, academics with a range of expertise, and health professionals.

Diabetes Australia–Victoria established a purchaser–provider arrangement whereby accredited providers are contracted to deliver Life!. This provider network comprises nonprofit, public sector, and private agencies. Life! providers employ facilitators certified to deliver Life!. As the program developed, a register of both Life! facilitators and providers has

	Session 1		Session 2		Session 3		Session 4		Session 5		Session 6	
Referral provides	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	8 months		
AUSDRISK tool score												
Height (cm)												
Weight (kg)												
BMI (kg/m ²)												
Waist (cm)												
Blood pressure (mm/Hg)	<ul style="list-style-type: none"> • A trained facilitator conducts the sessions • A physiotherapist / exercise physiologist cofacilitates one session • A dietitian cofacilitates one session 											
Total cholesterol (mmol/L)												
LDL (mmol/L)												
HDL (mmol/L)												
Triglycerides (mmol/L)												
Fasting plasma glucose (mmol/L)												

Figure 1—Life! consisted of a group-course six-session intensive intervention for 8–15 people.

been compiled to allow for greater flexibility and program reach. Life! facilitator training comprises a self-learning period, knowledge test, completion of the same practical tasks as program participants, and 2-day face-to-face training in skills for group facilitation and behavior-change techniques. Successful completion certifies the facilitator for 1 year. Continuing certification requires an annual review day attendance. The review day includes feedback on program and facilitator performance along with peer learning. Through the Life! program, a statewide workforce of professionals trained and certified in evidence-based type 2 diabetes prevention has been built. By 30 June 2011, 137 organizations were actively involved with the program and 302 facilitators had been trained.

The cost of delivering Life! to high-risk individuals was approximately \$400 per participant. This covers program facilitator costs and participant-related resources. The subsidy was paid to service providers in two installments after sessions 1 and 5.

Participants

The Australian diabetes risk tool AUSDRISK, a 10-item questionnaire (20,21), is used to assess an individual’s

risk for developing type 2 diabetes. Individuals belonging to one or more of the following groups were considered eligible:

- Aged 50 years and over, AUSDRISK score of 12 or more;
- Aged 18 years or older, indigenous Australians of Aboriginal and Torres Strait Islander descent who are at very high risk, AUSDRISK score of 12 or more; and
- Aged 18 years or older, previously diagnosed with high-risk conditions such as gestational diabetes mellitus or atherosclerosis-related CVD.

Exclusion criteria included existing diabetes, pregnancy, active cancer, and recent myocardial event.

Social Marketing and Communications

Increased awareness of diabetes risk and prevention across the community was created through integrated social marketing, which consisted of targeted communication activities and mass media campaigns. Media advertising, presence at key events such as a Life! booth at the Royal Melbourne Show, a 24-h telephone help line (13 RISK), and a website to promote risk assessment facilitated recruitment of high-risk

individuals and increased awareness of type 2 diabetes prevention effectiveness. The program was also promoted to health professionals, and a tailored workplace engagement program was also developed.

Recruitment

To June 2011, ~15,000 participants were referred into the program through four referral pathways. These were 1) referrals generated through Life! providers or facilitators (36.2%), 2) family physician/health professional setting recruitment (30.2%), 3) social marketing via telephone/web support system recruitment (28.2%), and 4) workplace-generated recruitment (5.4%). Provider- or facilitator-led recruitment involved Life! facilitators promoting the program to local workplaces and community groups and encouraging individuals to undertake the AUSDRISK test assessing their risk for type 2 diabetes. This form of recruitment became the most useful, especially after May 2010 when funding was available to Life! facilitators and other eligible entities to implement individual sessions with potential program participants aged over 50 years. Workplace-generated recruitment was limited due to establishing a process for referring

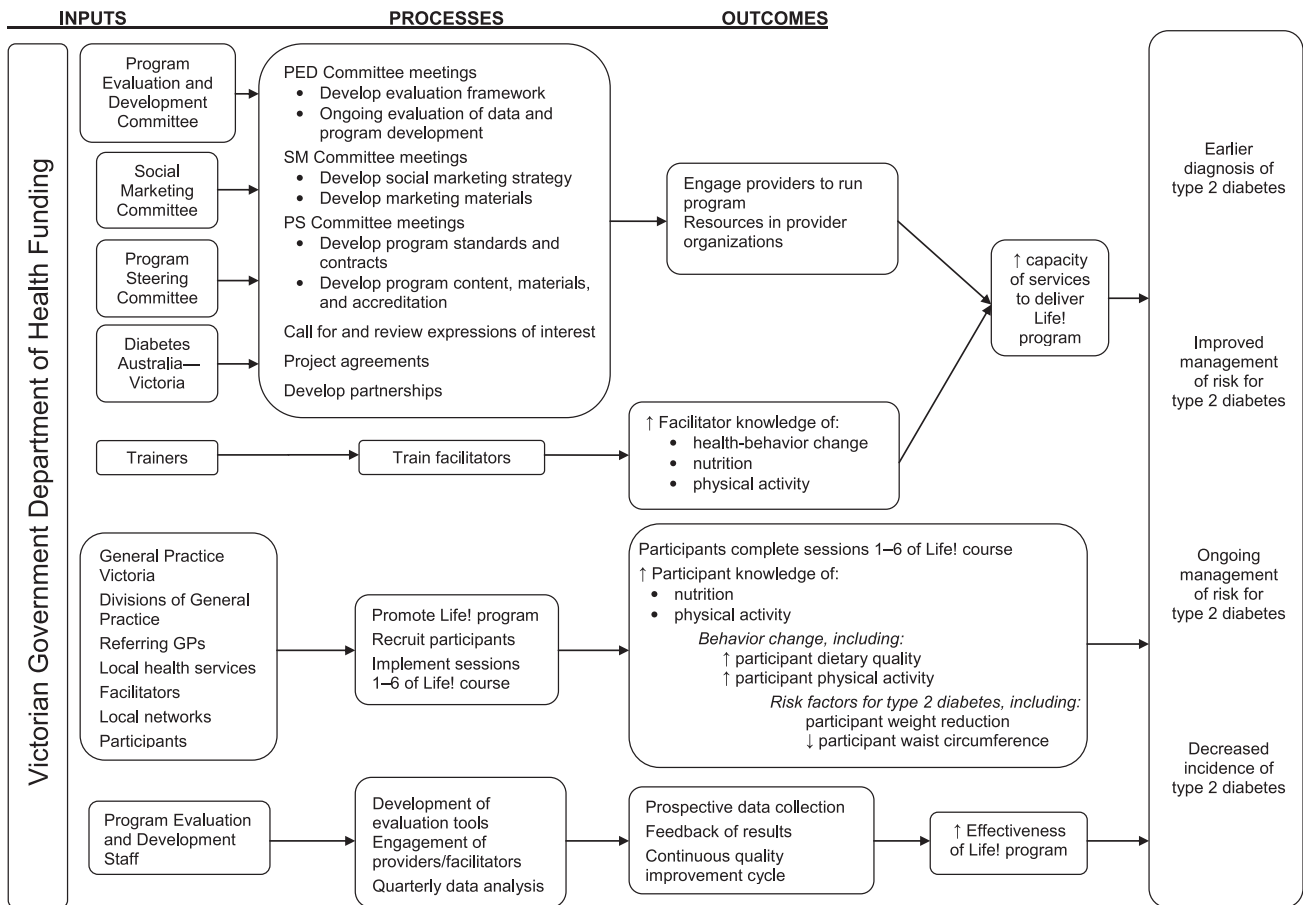


Figure 2—Various advisory committees assisted with development, implementation, and evaluation of Life!. GPs, general practitioners; PED, Program Evaluation and Development; SM, Social Marketing; PS, Program Steering; ↑, increased; ↓, decreased.

high-risk workers to the program while maintaining their confidentiality and privacy. The mix of referral pathways mitigated the risk of reliance on just one.

Measures

At baseline, self-reported measures of depression and anxiety (Hospital Anxiety and Depression Scale [HADS]) were obtained along with biomedical and demographic data such as blood pressure, fasting lipids and glucose, age, AUSDRISK score, BMI, education, income, smoking habits, CVD history, and employment status. Follow-up measures at sessions 1, 5, and 6 included participants' weight and waist circumference, measured by the facilitator. Participants also completed physical activity and food behavior questionnaires. To determine physical activity level and achievement of the physical activity program goal, participants were required to indicate the frequency with which they participated in

at least 30 min of moderate physical activity (seven response options ranging from "daily" to "not at all"). Participants who indicated "daily" physical activity of at least 30 min achieved the physical activity goal. To examine the fat and fiber eating habits of participants and achievement of the fat- and fiber-related program goals (referred together as "healthy eating goal"), the Fat and Fiber Barometer (22) was completed by the participants. The mean score achieved on this questionnaire was used as an indicator of healthy eating behaviors; a higher mean score indicated healthier eating choices. For the purpose of reporting the healthy eating goal achievement to the program's funding body, a mean score on the Fat and Fiber Barometer of ≥ 3.5 for men and ≥ 3.8 for women was used to define achievement. Participants' baseline weight was used to determine goal weight and therefore achievement of the 5% weight reduction goal at sessions 5 and 6.

Data Collection and Statistical Methods

Data were entered into a centralized web-based database by the course facilitator following sessions 1, 5, and 6. Statistical analyses were undertaken using IBM SPSS Statistics 21. Means with SEs and percentages are presented. Differences between groups at baseline were tested using two-sided independent *t* tests for continuous data and χ^2 tests for categorical data. Changes over time were tested with two-tailed paired *t* tests. For the purpose of this report, we have only considered participants who completed sessions 5 and 6 of Life! The projected reduction in diabetes risk over 5 years was estimated by assuming a linear relationship between percentage reduction in waist circumference and weight and reduction in diabetes risk and using the sample-size weighted results of the Finnish DPS and the U.S. DPP as reference studies (2–4).

RESULTS

Life! Outcomes

Since 2007, over 29,000 people in Victoria have been sent detailed information on how they can prevent diabetes. By 30 June 2011, 14,819 program referrals had been received, with 8,412 people having commenced session 1 of a Life! program. The baseline characteristics of this cohort presented in Table 1 cover those entering the program during the period from its commencement in October 2007 to 30 June 2011, the end of the first round of funding. Two-thirds were

women, and the mean age of all participants was 61.3 years (SE 0.1). Mild-to-severe levels of anxiety and depression were found in 3.6% and 17.7% of participants, respectively. The mean waist circumference was 109.7 cm (SE 0.2) for men and 102.5 cm (SE 0.2) for women. The mean BMI at session 1 was 31.2 kg/m² (SE 0.1) for men and 32.2 kg/m² (SE 0.1) for women (Table 1). Table 2 displays the outcomes for those that commenced Life! by 30 June 2011. In addition, the outcome measures of those who completed sessions 5 and 6 are reported separately in Table 2. The

Life! participants analyzed herein showed a sustained reduction in weight and waist circumference in addition to improvements in physical activity and healthy eating. Approximately 47% of participants who attended session 5 (*n* = 6,632) also attended session six (*n* = 3,114). The overall completion rate of Life! was approximately 37%; however, this may not be a true representation of retention. Life! providers were not reimbursed for conducting the final session (session 6), therefore this session may not have been available for participants to attend. After sessions 1

Table 1—Baseline characteristics of participants who have commenced the Life! program

	Men		Women		Total	
	<i>n</i> = 2,830	33.6%	<i>n</i> = 5,582	66.4%	<i>n</i> = 8,412	100%
Mean (SE) age	63.1 (0.2)		60.3 (0.1)		61.3 (0.1)	
Mean (SE) AUSDRISK score	19.6 (0.1)		18.4 (0.1)		18.8 (0.1)	
Mean (SE) waist circumference	109.7 cm (0.2)		102.5 cm (0.2)		104.9 cm (0.2)	
Mean (SE) BMI	31.2 kg/m ² (0.1)		32.2 kg/m ² (0.1)		31.9 kg/m ² (0.1)	
Mean (SE) weight	94.9 kg (0.3)		83.4 kg (0.2)		87.3 kg (0.2)	
Education						
Secondary	1,275	45.1%	2,621	47.0%	3,896	46.3%
Nonuniversity tertiary education	582	20.6%	1,020	18.3%	1,602	19.0%
University	379	13.4%	817	14.6%	1,196	14.2%
Primary	130	4.6%	264	4.7%	394	4.7%
Other (preprimary, no education, and other education) or not stated	464	16.4%	860	15.4%	1,324	15.7%
Income						
Low	1,461	51.6%	3,024	54.2%	4,485	53.3%
Middle	841	29.7%	1,398	25.0%	2,239	26.6%
High	242	8.6%	261	4.7%	503	6.0%
Not stated	286	10.1%	899	16.1%	1,185	14.1%
Current smoking						
Not at all or occasionally	2,618	92.5%	5,246	94.0%	7,864	93.5%
Daily	165	5.8%	240	4.3%	405	4.8%
Not stated	47	1.7%	96	1.7%	143	1.7%
CVD						
No	2,090	73.9%	4,795	85.9%	6,885	81.8%
Yes	740	26.1%	787	14.1%	1,527	18.2%
Employment						
Not working (home duties, unemployed, and retired)	1,146	40.5%	2,839	50.9%	3,985	47.4%
Employed	1,101	38.9%	1,730	31.0%	2,831	33.7%
Other or not stated	583	20.6%	1,013	18.1%	1,596	19%
HADS A						
Moderate-severe anxiety (≥11 score)	333	11.8%	988	17.7%	1,321	15.7%
Mild anxiety (8–10 score)	476	16.8%	1,117	20.0%	1,593	18.9%
Normal (≤7 score)	2,010	71.0%	3,455	61.9%	5,465	65.0%
Not recorded	11	0.4%	22	0.4%	33	0.4%
HADS D						
Moderate-severe depression (≥11 score)	134	4.7%	316	5.7%	450	5.3%
Mild depression (8–10 score)	348	12.3%	699	12.5%	1,047	12.4%
Normal (≤7 score)	2,338	82.6%	4,545	81.4%	6,883	81.8%
Not recorded	10	0.4%	22	0.4%	32	0.4%

"Smokes occasionally" is defined as not smoking every day. HADS A, HADS anxiety; HADS D, HADS depression.

Table 2—Mean and SE weight (kilograms) and waist circumference (centimeters) at baseline (S1), session 5 (S5), and session 6 (S6) of Life! course participants and percentage of Life! participants achieving each program goal

		N	Session		Difference between sessions
			S1	S5	
Males	Weight	2,246	94.8 (0.4)	93.1 (0.4)	−1.8* ^a (<0.1)
	Waist	2,246	109.6 (0.3)	106.8 (0.3)	−2.8* (<0.1)
	% achieving weight-loss goal	2,246	—	9.3	
	% achieving physical-activity goal	2,242	13.8	20.4	
	% achieving healthy-eating goal	1,784	32.7	68.1	
			S1	S6	
	Weight	1,141	93.6 (0.5)	90.8 (0.5)	−2.8* (0.1)
	Waist	1,141	109.0 (0.4)	105.0 (0.4)	−4.0* (0.2)
	% achieving weight-loss goal	1,141	—	25.9	
	% achieving physical-activity goal	1,038	14.5	21.9	
% achieving healthy-eating goal	865	33.5	72.8		
Females			S1	S5	
	Weight	4,386	83.0 (0.3)	81.8 (0.3)	−1.3* (<0.1)
	Waist	4,384	102.2 (0.2)	99.8 (0.2)	−2.4* (<0.1)
	% achieving weight-loss goal	4,386	—	7.1	
	% achieving physical-activity goal	4,370	8.5	13.4	
	% achieving healthy-eating goal	3,595	26.9	55.3	
			S1	S6	
	Weight	1,973	82.5 (0.4)	80.3 (0.4)	−2.1* (0.1)
	Waist	1,973	101.5 (0.3)	97.8 (0.3)	−3.6* (0.1)
	% achieving weight-loss goal	1,973	—	25.0	
% achieving physical-activity goal	1,830	9.6	15.1		
% achieving healthy-eating goal	1,571	29.6	60.8		
Total			S1	S5	
	Weight	6,632	87.0 (0.2)	85.6 (0.2)	−1.4* (<0.1)
	Waist	6,630	104.7 (0.2)	102.2 (0.2)	−2.5* (<0.1)
	% achieving weight-loss goal	6,632	—	7.9	
	% achieving physical-activity goal	6,612	10.3	15.8	
	% achieving healthy-eating goal	5,379	28.8	59.5	
			S1	S6	
	Weight	3,114	86.5 (0.3)	84.2 (0.3)	−2.4* ^a (<0.1)
	Waist	3,114	104.2 (0.2)	100.4 (0.2)	−3.8* (<0.1)
	% achieving weight-loss goal	3,314	—	25.3	
% achieving physical-activity goal	2,868	11.3	17.6		
% achieving healthy-eating goal	2,436	31.0	65.1		

Session 5 is 2 months after the initial session when baseline data were collected, and session 6 is 8 months after the initial session. *Significant at $P < 0.001$. ^aDiscrepancy between difference and table results due to rounding. The differences reported for weight and waist circumference between sessions 1 and 5 and for sessions 1 and 6 are based upon paired sample *t* tests.

to 5 of Life!, participants recorded a mean weight loss of 1.4 kg ($n = 6,632$; $P < 0.001$) and a mean reduction in waist circumference of 2.5 cm ($n = 6,630$; $P < 0.001$). Significant changes in the proportion of participants achieving the healthy eating goal and physical activity goal at session 1 compared with session 5 were demonstrated (28.8 vs. 59.5% and 10.3 vs. 15.8%, respectively; $P < 0.001$). Those participants completing Life! (sessions 1 to 6) recorded a mean weight loss of 2.4 kg ($n = 3,114$; $P < 0.001$) and a mean reduction in waist circumference of 3.8 cm ($n = 3,114$; $P < 0.001$). Significant changes in the proportion of

participants achieving the healthy eating goal and physical activity goal at session 1 compared with session 6 were recorded (31.0 vs. 65.1% and 11.3 vs. 17.6%, respectively; $P < 0.001$).

In relation to diabetes risk, a body weight reduction from 86.5 to 84.2 kg (2.8%) (Table 2) in Life! for those completing six sessions compares with reductions of 4.5 kg or 5.2% at 1 year in the Finnish DPS (2) and 6.8 kg or 7.2% at both 6 months and 1 year in the DPP (3). The Finnish DPS reported a 58% reduction in diabetes risk over 4 years and 43% reduction over 7 years (23). Interpolating on the basis of a linear model produces an imputed reduction

of diabetes risk of 32% and 21%, respectively, for Life!. The DPP reported a 58% reduction of diabetes risk over 2.8 years. Interpolating on the basis of a linear model produces an imputed reduction of diabetes risk of 23%. The DPP also reported reduction of waist circumference from 106.1 to 100.4 cm (24) (5.7 cm or 5.4%) associated with the reduction of diabetes risk by 58%. Reduction of waist circumference in Life! was from 104.2 to 100.4 cm (3.6%) (Table 2); interpolation for those completing six sessions predicts reduction of diabetes risk by 39%. Based on the loss of weight and reduction in waist circumference of participants in

this intervention, we impute, at 8 months, a potential diabetes risk reduction of 21–39%.

CONCLUSIONS

DPPs are widely described as delaying the onset of diabetes or turning back the metabolic clock in the glycemic continuum. Scaling up from an efficacy trial to a statewide DPP presents many challenges. Implementation failure is commonplace (25) because trials emphasize internal over external validity, which seldom provides sufficient information to allow successful scale-up. Moderating variables and issues of generalizability are frequently underreported (26).

Two evaluated, scaled-up DPPs have reported their results: FIN-D2D (12) in Finland and now Life! in Australia. There is also a recently started U.S. national DPP (27) derived from the Indianapolis (28), Montana (29), and Pittsburgh (30) implementation trials. Results of FIN-D2D include reductions in weight of 1.3 kg in men and 1.1 kg in women and 1.3 cm reduction in waist circumference at 1-year follow-up (13). Life! has demonstrated higher effectiveness than FIN-D2D probably due to the program's systems design with performance measurement.

Lessons Learned

Recruitment of participants into Life! was a key imperative. An arbitrary target of 25,000 people was chosen for funding purposes by the Victorian State Government in Australia. No other targets were set with respect to recruiting, selecting, or inviting participants, as this program was the first of its kind in Australia. The target of 25,000 individuals to be recruited over the initial 4-year period proved unrealistic, as the first year was largely spent establishing the program, including the tasks of methodological design and recruiting and training the workforce. During the third year, the participant recruitment rates exceeded the participation target. Time to build the workforce, provider network, and infrastructure necessary for supporting a large-scale program is an important consideration.

Some recruitment channels were easier to commence than others, and having

multiple recruitment channels was essential. Social marketing was an important contributor to recruitment and overall program development, promoting the program to the community, to those at risk, and to health professionals. Many health professionals were unaware of the relatively recent evidence about type 2 diabetes prevention. A significant barrier to recruitment included diabetes exclusion prior to program enrolment. To overcome this recruitment barrier, the requirements for Life! eligibility and referral were gradually revised and amended from late 2009. The implementation of the First Visit Initiative in July 2010, where Life! facilitators conducted individual information sessions with potential program participants, impacted positively on recruitment and increased program referrals. Significant investment is also required to ensure successful implementation in the areas of program coordination, leadership, facilitator training and certification, program materials, and social marketing and communications.

Due to Australian Medicare (Australian universal health cover) regulations, payment for repeat measurement at 3 months for lipid and glucose levels could not be made, which meant participants lost the opportunity to get feedback on reduction of their diabetes and CVD risk. It would be helpful to also cover biomedical testing during the intervention rather than just at the beginning. The Medicare policy on laboratory measurements for this type of program should be reviewed.

Initially, Life! targeted a high-risk population only and Victorians aged 50 years or older (excluding those with previous CVD/gestational diabetes mellitus history and Aboriginal and Torres Strait Island descendants). It was beyond the funding scope to expand the program to include lower-risk and younger demographics. The program was funded by the Victorian state government for an initial 4-year period (2007–June 2011), and funding has now been extended with an expanded remit to include prevention of both CVD and type 2 diabetes. At the same time, several program features were revised

with the aim of improving the impact of the program and implementation success. The age eligibility was reduced to 45 years; the structure of the program was revised from a six-group-session structure to a one-on-one session followed by five group sessions. Furthermore, Life! initially had a payment system whereby providers were remunerated for each participant at three time points, dependent on attendance and completion of minimum participant data requirements for program evaluation. The payment structure and method for the sessions, especially having no specific payment for session 6, has contributed to the high apparent dropout rate, although the 63% dropout rate is not a true representation of retention (as the final session may not have been conducted, and therefore participants would not have had the opportunity to attend). The payment structure has now been revised to four time points to ensure session delivery and to encourage service providers to maximize retention, particularly between the final two sessions.

The imputed reduction of diabetes risk was calculated on the basis of comparisons of weight reduction in the DPP (3) and the Finnish DPS (2) and waist circumference in the DPP. There are a number of assumptions made, the first being that the relationship between weight or waist loss and reduction in risk of diabetes is linear, and so the estimation is an interpolation along a linear relationship. Other assumptions or approximations rely on the finding that in the Finnish DPS, weight reduction was the only significant association in a multivariate model (23) and that waist reduction is a better predictor of reduction of diabetes risk (31). The intervention in Life! reported in this paper was based on the same principles with comparable interventions to the Finnish study. Based on evidence from the Finnish DPS (2) that risk related to weight tends toward linearity, an interpretation of the impact of the Life! program is that weight reduction should or can have a similar effect. For each kilogram lost, the risk of type 2 diabetes mellitus is reduced by 16% (where 16% per

kilogram is a relative risk reduction rather than an additive approach) (32). Life! is modeled on three Finnish studies (2,9,12), and other work conducted in Finland (13,33) suggests that reduction in diabetes risk follows a linear trend with a greater decrease in risk corresponding to more of the goals attained. In Life!, other factors such as healthy eating and physical activity are additional contributory factors along with weight loss. It is widely accepted that large degrees of weight loss give the best result; however, modest degrees of weight loss are still helpful. In this light, the Early ACTID (Activity in Type 2 Diabetes) (34) randomized controlled trial showed that mean weight loss of 2.3 kg and a reduction in waist circumference of 2.5 cm at 6 and 12 months improved glycemic control and insulin resistance. Furthermore, in the Look AHEAD (Action for Health in Diabetes) study, the effect on diabetes remission was by tertiles of weight loss rather than a defined threshold (35).

It is not possible to estimate the population effect, because the proportion of high-risk individuals participating in the program is unknown. Due to a lack of funding for follow-up of participants in Life!, participants' results after the completion of six sessions cannot be reported. Without follow-up of participants who completed Life!, it is not possible to estimate what the delay to the onset of diabetes will be as a result of participating in Life!. By comparison, in the GGT DPP, follow-up of participants at 30 months demonstrated that beneficial changes achieved by participants were generally sustained, with the exception of fasting plasma glucose and some psychological measures (14).

An important lesson learned from this program is that the effect of large-scale programs can be smaller than those derived from clinical trials. Participants who completed all six sessions of Life! experienced less weight loss after year 1 when compared with the DPP and the DPS. The same phenomenon was observed within FIN D2D in Finland. Such a lesson gives future program implementers a good estimate for

public health impact when scaling up from a clinical trial to the general population at risk. Furthermore, the waist and weight loss presented in Table 2 for sessions 5 and 6 cannot actually be compared, as the cohorts in these follow-ups are not the same. With smaller number of individuals and greater resources, a much more intensive intervention was carried out in the clinical trials (including free access to a gym and face-to-face dietary guidance).

Overall, 8,412 participants commenced the program, and 6,632 completed to session 5 (1,780 dropped out between sessions 1 and 5). The retention rate for sessions 1 to 5 was 78.8%. Since Life! is not a randomized controlled trial, the 6,407 referred individuals who failed to attend any one or more of the sessions were not followed up due to lack of time and limited resources, which are inherent in a scaled-up real-world program.

Significance of Our Findings

The epidemic of type 2 diabetes requires all governments and policymakers to address the need for both population-based approaches to obesity prevention and large-scale intervention programs for the large high-risk population (36). It is important that primary care practitioners and other health professionals recognize that structured evidence-based lifestyle behavior-change programs such as Life! and FIN-D2D can reduce risk—and are different from market-driven weight loss programs and generalized health/wellbeing programs.

Implementing real-world large-scale lifestyle behavior-change programs is not easy. System design retaining the goals of the Finnish DPS, adding behavioral theories of change, and using principles of continuous quality improvement with performance management based on outcome data are significant system features of the program reported here and informed modifications in mid-2011 for the next statewide program.

Programs to integrate workforce training and development, provider networks to keep health professionals engaged, multiple recruitment

channels, and integrated social marketing activities are also important system components for a successful outcome. Fundamental to the scaling-up process to provide an extensive and sustainable intervention is creating and maintaining a forum that brings policymakers, implementers, and evaluators together.

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