

Ten Years Follow-Up of a Community-Nurse Managed Intervention to Improve Diabetes Control

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Background and Purpose: Diabetes control measures were shown to improve, following multidisciplinary intervention managed by a nurse in short-term follow-ups. However, there is a lack of data regarding the long-term effects of such interventions. We assessed long-term diabetes management and control measures in a central multidisciplinary primary care clinic, following a brief intervention conducted by a community nurse. **Methods:** A cross-sectional study in a central, multidisciplinary, primary care clinic. A previous study cohort of randomly selected 100 people with diabetes was followed-up for over 10 years, following a brief intervention managed by a community nurse. Data of diabetes control measures (e.g., hemoglobin A1c [HbA1c], low-density lipoprotein [LDL], and blood pressure) and clinical use of medical

services (e.g., nurse, physician, dietician, and hospitalizations) were extracted from the medical records and compared from before the intervention to short and long-term follow-ups (median of 25 months, 10.56 years respectively). **Results:** During the follow-up period, 18 participants (median age at intervention time 73 years) died. HbA1c dropped significantly ($p < .001$) from before to after the intervention, and remained low. LDL and Systolic Blood pressure decreased and continued to decrease during the long-term follow-up. While the number of nurse visits per year increased, physician and dietician visits decreased. Annual foot examinations and ophthalmologist visits, which increased following the intervention, remained high. Diabetes-related hospitalizations also decreased from the point of intervention. **Implications for Practice:** Multidisciplinary, brief intervention managed by a community nurse, improve, and even continue to improve, most diabetes management and control measures, for more than 10 years following the intervention.

Keywords: nurse; disease manager; diabetes; primary care; long-term follow-up

Long-term diabetes control is a major task for the medical personnel in the primary care clinic. Several models have been created to improve the quality of care and counseling patients with chronic diseases, either only by physicians or in a physician–nurse combination, both in the community or hospital settings (Bodenheimer et al., 2002). Many studies attempted to identify and characterize chronic diseases' management and case managers' role in the program (Aliha et al., 2013; Huston, 2001; Jones, 2015; Watts & Sood, 2016).

It was found that nurses have a significant effect when counseling patients on self-management of their condition, particularly when combined with the proactive care management model and decision-making support (Aliha et al., 2013; Hainsworth, 2005; Washburn & Hornberger, 2008; Watts & Sood, 2016). Berra et al. have shown that nurses' structured personal supervision, based on guidelines, can significantly contribute to lowering cardiovascular morbidity and mortality (Berra, 2011). Another study showed lower hemoglobin A1c (HbA1c) and blood pressure (BP) levels, lifestyle changes including diet and exercise, and lower depression rates, with a nurse as a case manager compared to a standard of care (Li et al., 2017). Similar results were also shown in other studies in various community settings (Hiss et al., 2007; Ishani et al., 2011). Recent studies have also described telemedicine's benefits by a nurse to support patients to achieve better diabetes control. However, better chronic disease control's health benefits were proven to last during the intervention periods and shortly following the interventions (McLendon, 2017).

Diabetes complications such as retinopathy, nephropathy, or neuropathy usually occur 5 and even 10 years following the diagnosis of diabetes (Alvarsson & Grill, 1989; Franco-da-Rosa et al., 2019). Therefore long-term follow-up (LTFU) of diabetes and assessment of diabetes control is highly important in diabetes complication risk reduction (Alvarsson & Grill, 1989). LTFU of diabetes in various studies is usually defined as 5–10 years from the onset of diabetes (Chen et al., 2014; Feldbrin et al., 2018; Franco-da-Rosa et al., 2019; Grover et al., 2020; Heier et al., 2018; Lacy et al., 2018; Miyazaki et al., 2019). However, the range of LTFU is also referred from

less than 3 years of follow-up to more than 10 years (Grover et al., 2020; Miyazaki et al., 2019; Yamamoto et al., 2016).

In our previous study (Ginzburg et al., 2017), we showed that short-term follow-up (STFU) period (6 months) following multidisciplinary intervention managed by a nurse improved diabetes management and control measures. The clinic nurse led the intervention process and managed the care according to the model of chronic disease management. The changes included improvements in hemoglobin A1c (HbA1c), low-density lipoprotein (LDL), and systolic BP control; as expected, general practitioner (GP), ophthalmologist, and dietician visits increased significantly during the study, whereas the rate of total and diabetes-related hospitalizations decreased. These changes persisted after the intervention period, with a median follow-up of 25 months.

The literature, including a Cochrane review, lacks proof that these changes can last for long-terms (Loveman et al., 2008). Hence, it was still to be determined if the improved control measures continued in a LTFU. As discussed above, LTFU of diabetes is usually considered 5–10 years of follow-up. Therefore, this study follows the same cohort of patients to determine if improvement in diabetes control measures can last in a LTFU of over 10 years following a brief intervention managed by a community nurse in a multidisciplinary clinic.

METHODS

The purpose of this study was to assess the long-term diabetes management and overall control measures in a central primary care clinic, following a short intervention conducted by a nurse. The study used a retrospective, cross-sectional design.

Maccabi Healthcare Services is the second-largest health maintenance organization (HMO) in Israel, insuring about 2,800,000 patients. All medical follow-up, and medical care is utilized through a computerized medical record used by all the HMO staff. Some clinics function with a multidisciplinary team, including primary care physician, nurse, social worker, pharmacist, physical exercise consultant, and other medical specialists. These clinics care for patients with chronic diseases and can perform specific interventions for predefined populations.

In Maccabi Health Services, Sharon District, a multidisciplinary team clinic has been active since 11/2008. The clinic currently cares for about 12,000 patients, 1,000 of whom have diabetes. During 2008–2013, patients with diabetes received specific short-term (6 months) interventions according to a predetermined protocol, and the clinic nurse performed the treatment management. Due to personnel issues, the proactive interventions were stopped by 2013, and all the patients with diabetes continued routine follow-ups in the clinic. All medical data regarding these patients (clinic visits, medications, lab results, etc.) are documented in the medical records, and the research was carried out by systematic data retrieval from the medical database. The short-term intervention procedure, managed by the clinic nurse, consisted of identifying people with diabetes with nonoptimal glucose

control (HbA1c > 7%). These patients were invited to see the clinic nurse (who had specialty training in diabetes), either by direct summoning or by referral from the patient's physician. Patients received personal guidance regarding the disease, the importance of treatment and control, avoiding complications, explanations on self-management and empowerment, correct use of blood glucose meters, and home sphygmomanometers. They were also provided referrals to consultants and the necessary providers for continued care and follow-up (ophthalmologist, dietician, social worker, physical exercise counselor, etc.). During the 6 months intervention, the patients were called in for follow-up visits, and received telephone reminders and counseling to monitor themselves according to the accepted recommendations (Ginzburg et al., 2017). All interventions were made by a nurse, according to the current ADA recommendations.

According to the research protocol, the medical records of the 100 randomly selected patients' cohort of the previous study were followed up (Ginzburg et al., 2017). This allowed a follow-up period of 10 years following the intervention.

We collected the same Diabetes control measurements (cholesterol and HbA1c levels, urinalysis, BP, eye and feet exams, and the clinic staff follow-up).

The research was approved by the institutional research committee and by the institutional ethics committee (institutional review board [IRB]).

We used descriptive statistics to evaluate the different variables and compared the results of the baseline, STFU, and LTFU periods by student *t* test and chi-square. The data was collected and analyzed anonymously using SPSS version 25.

RESULTS

In the current research, we collected data on the 100 people with diabetes who were randomly selected for the previous study. Median follow-up from the intervention was 126.72 months (10.56 years). Of the 100 patients' cohort, 18 patients died (average age at baseline was 70.35 years±10.71, median 73 years) during the follow-up period, and three patients changed their HMO, so long-term data was not available (Figure 1). Long-term data analysis was completed for 79 patients. Patient data during the study periods are presented in Table 1 for the long-term cohort and for the lost to follow-up, and patients who died during the follow-up period in Table 2. For the various measurements, comparisons were made between the baseline period, the intervention and STFU, and the LTFU periods.

Whereas *HbA1c* averages before the intervention dropped significantly during the intervention period ($p < .001$), it remained low during the STFU period ($p = .697$) and showed only a slight increase in the LTFU ($p = .658$). *LDL levels* showed a similar decrease before the intervention period to the intervention period ($p < .001$) with no change to the STFU ($p = .533$), but the LDL levels further decreased to the LTFU ($p = .021$). *Systolic BP levels* showed a similar decrease in the intervention period ($p < .001$) and a stable status to the STFU ($p = .554$). Still, the levels continued with a further decrease between STFU to the LTFU ($p = .031$). During the intervention, nurse visits increased significantly ($p < .001$), as expected, with a subsequent decrease in

the STFU. However, the number of annual nurse visits in the LTFU doubled ($p < .001$). Significant changes were also observed in phone reminders, dietician and physician appointments, showing an increase during the intervention with a gradual, significant decline to the STFU and the LTFU.

Clinical guidelines for diabetes recommend a yearly foot examination. The rate of preventive foot examinations increased from 24.1% to 93.7% during the intervention and decreased to a stable level of 67.1% in the STFU and LTFU. A similar trend was observed in the annual completion of ophthalmologist visits (Harding et al., 2019; Loveman et al., 2008).

Diabetes-related hospitalizations decreased to zero from the point of intervention and remained zero. However, an increase was observed in all-cause hospitalizations during LTFU.

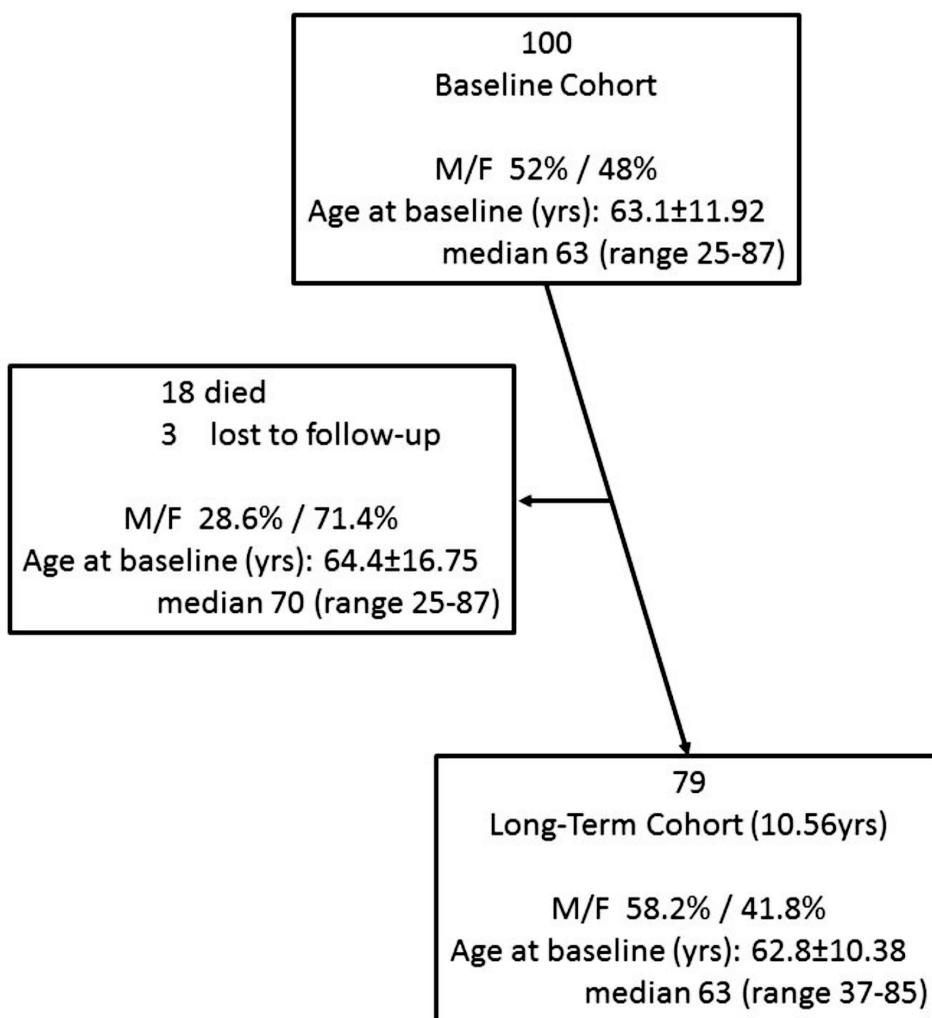


Figure 1. Description of the cohort characteristics.

TABLE 1. Preintervention to Long-Term Follow-Up (n = 79)

	Preintervention (up to 1 year) ^a		Intervention Period (0–½ year)		First Follow-Up Period (Median 25 months)		Long-Term Follow-Up (Median 10.56 yrs)	
	Average	n	Average	n	Average	n	Average	n
HbA1c	8.157 ± 1.76	74	7.09 ± 1.03**	71	7.18 ± 1.03	69	7.35 ± 1.52	78
LDL-cholesterol	108.61 ± 36.19	76	92 ± 31.04**	65	91.12 ± 27.61	66	82.73 ± 31*	75
Systolic blood ressure	146.53 ± 23	78	134.35 ± 16.57**	62	134.02 ± 17.84	57	129.27 ± 11.7*	79
Phone reminders/visits (n/yr)	<0.1 ^b		3.02 ± 4.72**		2.18 ± 3.94		1.24 ± 2.22	
Nurse visits (n/yr)	none ^b		5.12 ± 3.39**		1.94 ± 3.36*		3.88 ± 2.56**	
Dietician visits (n/yr)	0.44 ± 1.49 ^b		2.54 ± 2.64**		0.74 ± 1.84**		0.2 ± 0.4**	
Physicians visits (n/yr)	10.82 ± 8.7 ^b		16.3 ± 8.82**		14.96 ± 10.05		12.02 ± 4.4	
Foot examination	24.1% ^b		93.7%**		67.1%		67.1%	
Ophthalmologist visits	53.2% ^b		93.7%**		72.2%		81.0%	
Hospitalizations (DM related) (n/yr)	0.08 ± 0.5 ^b		None**		None		None	
Hospitalizations (all cause) (n/yr)	0.06 ± 0.318 ^b		0.06 ± 0.318		0.06 ± 0.318		0.48 ± 1.26**	

Note. DM = diabetes mellitus; HbA1c = hemoglobin A1c; LDL = low-density lipoprotein. Data presented are last test result, or rate per last year of follow-up.

^aPreintervention - up to 1 year before the intervention.

^bDuring the period of -(1-½) year before the intervention.

p* < .05. *p* < .01 *p*-values were calculated between each periods to the preceding period.

TABLE 2. Preintervention to First Follow-Up, for Patients Who Were Lost to Follow-Up ($n = 21$)^a

	Preintervention (up to 1 year) ^b		Intervention Period (0–½ year)		First Follow-Up Period (Median 25 months)	
	Average	<i>n</i>	Average	<i>n</i>	Average	<i>n</i>
HbA1c	8.91 ± 2.15	19	7.55 ± 1.35	19	7.71 ± 1.57	20
LDL-cholesterol	91.35 ± 37.75	17	87.53 ± 21.88	19	90.74 ± 89.5	20
systolic blood pressure	151.78 ± 29.13	18	134.25 ± 14.51	16	138.92 ± 25.02	12
Phone reminders/ visits (n/yr)	None		4.76 ± 6.08		1.90 ± 2.98	
Nurse visits (n/yr)	None		6.48 ± 5.1		0.76 ± 1.34	
Dietician visits (n/yr)	0.86 ^c ± 1.62		1.62 ± 2.24		0.58 ± 1.8	
Physicians visits (n/yr)	12.38 ^c ± 10.92		22.28 ± 12.58		16.86 ± 10.94	
Foot examination	33.3% ^c		95.2%		61.9%	
Ophthalmologist visits	28.6% ^c		85.7%		47.6%	
Hospitalizations (DM related) (n/yr)	0.1 ^c ± 0.436		0.1 ± 0.436		0.1 ± 0.436	
Hospitalizations (all cause) (n/yr)	0.38 ^c ± 1.024		0.1 ± 0.436		0.48 ± 1.4	

Notes. DM = diabetes mellitus; HbA1c = hemoglobin A1c; LDL = low-density lipoprotein. Data presented are last test result, or rate per last year of follow-up. Due to small samples, *p* values were not calculated.

^a21 patients who were lost to follow-up, 18 patients died during follow-up period, and 3 changed HMO.

^bPreintervention - up to 1 year before the intervention.

^cDuring the period of -(1–½) year before the intervention.

DISCUSSION

Long-term diabetes control is one of the significant challenges in all healthcare systems, whereas good diabetes control offers a reduced risk for complications and associated costs (Alvarsson & Grill, 1989; Franco-da-Rosa et al., 2019). Teamwork among the medical personnel can contribute to both the quality of care and help to improve diabetes control measures. However, previous studies failed to show these improvements' long-term effects (Loveman et al., 2008). Various studies have examined the role of the disease care manager (Aliha et al., 2013; Ginzburg et al., 2017; Jones, 2015; Watts et al., 2009; Watts & Sood, 2016). Our previous study showed that multidisciplinary intervention managed by a nurse, improved diabetes management and control measures. These benefits were showed to persist after the intervention period to a median follow-up time of 25 months (STFU). Here, we showed these improvements lasted even more than 10 years after the intervention (LTFU).

During the LTFU study, 18 patients whose median age at baseline was 73 years, died, and three other patients were lost to follow-up (changed HMO or immigrated). As this study describes more than 10 years of follow-up, these patients should have

approached their mid 80s. Furthermore, these patients had a higher baseline HbA1c and systolic BP, with significantly higher baseline hospitalizations rates than the rest of the study population. Therefore, all the analyses were completed for the 79 patients who completed the 10.56 years LTFU period, 58.2% males, and median age at baseline of 63 years (range 37–85).

During the LTFU, all patients received routine medical care with no specific intervention, other than the intervention at baseline. Accordingly, the rates of phone reminders during the LTFU dropped. Table 1 shows a rather stable decrease of HbA1c, LDL, and systolic BP from baseline, through STFU and LTFU. Although a slight, nonsignificant increase of HbA1c to LTFU was observed, LDL levels and systolic BP continued to decrease during the follow-up. This may reflect a stable and positive effect of the short-term intervention at baseline, that continued, post intervention. During the past 10 years, new medications have been introduced for diabetes type 2. However, as the baseline intervention included empowering the patient and giving tools to cope with diabetes, it is not surprising that the improvements in these clinical measures continued.

Interestingly, the patients continued to seek nurse visits, with a doubling in the number of visits from STFU, while the number of dietician and even physician visits decreased. This may indicate the patients' perception of the nurse as the case manager by the patients. Furthermore, previous studies comparing nurse and primary care physicians concluded equal or even better outcomes in the nurse manager setting (Brown et al., 2016; Kim et al., 2016; Watts & Lucatorto, 2014). Scheduling an appointment and visiting the clinic for foot examination, and an ophthalmologist for an annual checkup as recommended by accepted clinical guidelines for diabetes, are patient-initiated examinations. These were multiplied during the intervention and remained high during STFU, and even increased during the LTFU. This implies the assimilation of the medical knowledge and routine follow-up habits that were taught during the intervention.

Schnider et al. showed that persons with diagnosed diabetes are at a significantly elevated risk of hospitalization, including endocrine, infection, and iatrogenic/injury causes (Schneider et al., 2016). We also observed an increase in the number of all-cause admissions during the LTFU, but with no diabetes-related hospitalizations. While all-cause hospitalizations in this population are expected to increase, the improved diabetes control and follow-up may have prevented the diabetes-related hospitalizations.

LIMITATIONS

Our study has several limitations. First, the study population was composed of people with diabetes from a central urban multidisciplinary clinic, which may not represent rural or peripheral clinics. Further research could be conducted in a wider geographical range. Second, the study population was rather small. However, the significant changes from baseline were kept during STFU, and until the LTFU (while these even improved for LDL or systolic BP). Furthermore, this is a LTFU of over 10

years following a specific intervention. Third, apart from the people who died during the LTFU, three people were lost to follow-up. However, this reflects a rather small number of patients lost to follow-up for more than 10 years. Further large scale studies will be needed to characterize LTFU data within different age groups.

CONCLUSION

The results of our study show that a short-term intervention by a multidisciplinary team managed proactively by a nurse significantly improved, and even continued to improve, diabetes control in almost all measures examined. These improvements are observed in the postintervention follow-up period and last for more than 10 years following the intervention. The study indicates the importance of patient empowerment and assimilation of the knowledge and practice to control diabetes. The participants also showed an increasing reliance on nurses in comparison to other members of the clinic, including the physician. Policymakers should consider interventions to increase diabetes control and education, managed by nurses.

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