Using EMR data to evaluate a physician-developed lifestyle plan for obese patients in primary care

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Abstract

Objective To use primary care electronic medical records (EMRs) to evaluate the effects of a lifestyle intervention delivered to obese patients compared with obese patients who did not receive the intervention.

Design Retrospective cohort analysis using EMR data derived from the Canadian Primary Care Sentinel Surveillance Network.

Setting A primary care clinic in rural Alberta.

Participants Obese adult patients with at least 1 weight measurement in the time periods before and after the intervention, grouped by patients who received the intervention (n = 68) and those who did not (n = 365).

Intervention Physician-developed lifestyle plan to address obesity through a variety of health-promoting recommendations.

Main outcome measures Mean change from before the intervention for weight, blood pressure, glycated hemoglobin A_{1c} level, and body mass index measurements, compared between the control and intervention groups.

Results Negligible weight change was observed in both groups, with the exception of older male patients (65 years and older) receiving the intervention, who lost significantly more weight than older men in the control group (a difference in mean reduction of 3.02 kg in favour of the intervention; $P = .008$). No overall group differences were seen in the secondary health outcomes, except for reductions in systolic and diastolic blood pressures in the intervention group ($P = .002$ and $P = .04$, respectively). Only the difference in systolic blood pressure remained significant after adjusting for covariates ($P = .01$).

Conclusion Providing real-time feedback about clinical interventions is possible using EMR data. Although the lifestyle intervention was associated with significant weight loss for a specific group of patients only, with the use of EMR data the cohort can be followed over time and additional health outcomes can be monitored. There is potential for individual physicians and practices to assess and improve clinical processes and interventions in a rigorous, timely, and manageable way.

EDITOR'S KEY POINTS
- A simple lifestyle and dietary intervention distributed to obese patients by a family physician as part of routine clinical care was associated with significant weight loss in older men and a significant reduction in systolic blood pressure for all participants.

- These findings support the physician's observation that the intervention appeared to be beneficial, although the scale of advantage was less than the physician proposed.

- A trade-off exists between the intensity and extensiveness of an intervention and its probable effect size. Simple interventions are more practical in real-world practice, but are often difficult to evaluate. Using routinely collected electronic medical record data for purposes of evaluation and research might provide objective perspectives on clinical activities and patient outcomes for large samples of patients, over substantial periods of time, at reasonable cost.

Utilisation des données du DME pour évaluer l'efficacité d'un plan créé par un médecin à l'intention de patients obèses et portant sur le mode de vie, et ce, en contexte de soins primaires

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Résumé

Objectif À l'aide des dossiers médicaux électroniques (DME), évaluer les effets d'une intervention sur le mode de vie offerte à des patients obèses, par rapport aux changements observés chez des obèses qui n'ont pas bénéficié de cette intervention.

Type d'étude Analyse de cohorte rétrospective à l'aide des données des DME extraites du Réseau canadien de Surveillance sentinelle en soins primaires.

Contexte Une clinique pour soins primaires d'une région rurale de l'Alberta.

Participants Patients adultes obèses dont le poids avait été mesuré au moins une fois dans les périodes de temps précédant et suivant l'intervention, répartis entre un groupe ayant reçu l'intervention (n = 68) et un autre ne l'ayant pas reçue (n = 365).

Intervention Un plan d'intervention sur le mode de vie conçu par un médecin pour contrer l'obésité et favoriser une meilleure santé.

Principaux paramètres à l'étude Changements moyens du poids, de la tension artérielle, du niveau de l'hémoglobine A1c et de l'indice de masse corporelle existants avant et après l'intervention, et entre les deux groupes.

Résultats Des changements de poids négligeables ont été observés dans les deux groupes, sauf chez les patients mâles plus âgés (65 ans et plus) qui ont reçu l'intervention, qui ont perdu significativement plus de poids que ceux du même âge du groupe témoin (une différence moyenne de 3,02 kg pour la perte de poids, en faveur de l'intervention ; *P* = ,008). Dans l'ensemble, il n'y avait pas de différence entre les groupes quant aux issues de santé secondaires, à l'exception d'une réduction des tensions artérielles systoliques et diastoliques dans le groupe ayant reçu l'intervention (*P* = ,002 et *P* = ,04, respectivement). Seule la diminution des tensions artérielles systoliques demeurait significative après ajustement pour les covariables.

Conclusion Il est possible d'obtenir du feedback en temps réel sur des interventions cliniques en se servant des données des DME. Même si l'intervention sur le mode de vie s'est accompagnée d'une perte de poids significative seulement dans un groupe spécifique de patients, l'utilisation des données des DME permet de suivre la cohorte dans le temps et de monitorer d'autres paramètres de santé. Pour les médecins individuels comme pour les cliniques médicales, il est possible d'évaluer et d'améliorer les processus et les interventions d'une façon rigoureuse, opportune et praticable.

POINTS DE REPÈRE DU RÉDACTEUR

• Une simple intervention portant sur le mode de vie et sur l'alimentation, créée par un médecin de famille et présentée à des patients obèses à l'occasion d'une rencontre de routine, s'est accompagnée d'une perte de poids significative chez les hommes plus âgés et d'une réduction significative de la tension artérielle systolique chez tous les participants.

• Ces résultats appuient l'opinion du médecin selon laquelle l'intervention est bénéfique, bien que l'ampleur de l'amélioration ait été moindre que celle qu'il attendait.

• Il existe une certaine relation entre l'importance et l'intensité d'une intervention et l'ampleur possible de son effet. Les interventions simples sont plus pratiques dans les circonstances habituelles, mais elles sont souvent difficiles à évaluer. L'utilisation des données généralement consignées dans les dossiers médicaux électroniques (DME) dans un but d'évaluation et de recherche pourrait offrir une idée objective des résultats des activités cliniques et des issues pour les patients, et ce, pour un échantillon important de patients, sur une importante période de temps et à un coût acceptable.

Recent data from the Canadian Health Measures Survey indicate that 27% of men and 25% of women across the country are obese.[1] The data demonstrate an apparent age gradient, with obesity rates increasing with age.[1] A systematic review found that targeted, multicomponent, and long-term interventions were most effective for weight loss, particularly those with a focus on low carbohydrate intake, individualized nutritional counseling, and regular contact with a health care professional who could also provide motivation and encouragement.[2] However, although there is an abundance of recommendations for weight loss interventions, translating these strategies to a health care setting can be challenging.[2] Many recommendations are based on conclusions from randomized trials, which do not represent "real-world" environments.[3] In addition, programs implemented as part of improving clinical care might be difficult to evaluate empirically, given busy staff schedules and limited resources.[3]

A potential solution involves exploiting the wealth of data found in primary care electronic medical records (EMRs), which provide a longitudinal description of weight progression, as well as relevant demographic characteristics and comorbidities. The Canadian Primary Care Sentinel Surveillance Network (CPCSSN) is the country's first national EMR database, developed for the purposes of primary care research, disease surveillance, and quality improvement.[4] With more than 500 family physicians and nurse practitioners participating nationally (termed *sentinels*), CPCSSN is able to extract de-identified data from 12 EMR systems, and clean, process, and standardize these data into a usable format.

A sentinel physician practising in a rural Alberta clinic enlisted CPCSSN to assist in the evaluation of a lifestyle intervention developed for obese patients. Ideally, interventions delivered in primary care settings will be subject to timely, straightforward assessment to determine their effectiveness and appropriateness, and whether they should be incorporated into routine clinical care. With EMR data available for the entire clinic, it was feasible to analyze the physician-specified outcomes of interest and gain insight into the effects of the lifestyle plan.

Objective

The objective of this analysis was to use EMR data to evaluate health outcomes for obese patients as a result of a physician-developed lifestyle intervention. The primary outcome was mean weight change. Secondary outcomes were mean changes in blood pressure, glycated hemoglobin (HbA_{1c}) level, and body mass index (BMI).

METHODS

Setting and study sample

The lifestyle intervention was developed and implemented by a family physician practising in a rural,

multidisciplinary clinic in southern Alberta that serves a population of approximately 10 000 people, including 2 large First Nations communities. Patients who were 18 years and older, had a BMI of 30 kg/m^2 or greater, and were assigned to the intervention physician's care received individual counseling according to the lifestyle plan. Adult obese patients who were assigned to any of the other 9 physicians in the clinic did not receive the intervention and thus formed the control group. Assuming 100 patients received the intervention and an equal number did not receive it, the analysis was estimated as having greater than 95% power for detecting a clinically significant difference of 2.5 kg in mean weight reduction between the groups at the 5% significance level.

Intervention

The evidence-based recommendations that formed the lifestyle plan were designed to promote weight loss and create long-term healthy habits by using a series of simple guidelines focused on nutrition,[5,6] physical activity,[7] water intake,[6] sleep,[8] smoking cessation,[9] and supplements[5,10-12] (**Figure 1**). The plan was designed to be simple and was printed on an easy-to-read card with a magnetic backing for patients to adhere to their refrigerators. The card was distributed to all obese patients

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Figure 1. Lifestyle intervention card for patients

LIFESTYLE PROGRAM

Drink 2 glasses of water before each meal

STOP	FOCUS ON
Bread	Smaller portions and plate size
Potatoes	Skinless chicken and turkey
Processed meats	Fish and tofu products
Candies	Coloured vegetables
Cookies and desserts	Fruit, berries, and nuts
Pop	Bran
Alcohol	Water
Cheese	Skim milk
Sugar	Supplement with

- Vitamin D3 (2000 IU/d)
- Omega-3 (3 capsules/d)
- Acetylsalicylic acid (81 mg/d, unless contraindicated)

DO NOT SMOKE

Get 30 min of vigorous exercise/d
—watch "23 and ½ Hours" on YouTube

Sleep 7 h per night

No salt added

If you stick to it, it will work. Good luck!

Physician signature:

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assigned to the intervention physician from April 2008 onward and referred to at subsequent clinic visits as the basis for clinical decision making and reinforcement of the recommended lifestyle changes. The intervention physician reviews the details of the lifestyle card with patients and discusses potential challenges. Whenever possible, spouses are involved in the process. Follow-up visits include weight measurements, praise or encouragement, and if necessary, a referral to an appropriate member of the multidisciplinary team housed within the clinic.

Design and data collection

A retrospective longitudinal cohort design was used to evaluate the intervention, using 2 distinct time periods: before the intervention (April 1, 2007, to March 31, 2008) and after the intervention (April 1, 2009, to March 31, 2012). The clinic is participating in CPCSSN and allows de-identified patient data to be extracted quarterly from its Wolf EMR system. All data are cleaned, processed, and standardized by CPCSSN algorithms and stored in a high-security data repository; CPCSSN maintains strict privacy and data security protocols, with research ethics approval from all 10 network sites,[13] including from the Conjoint Health Research Ethics Board at the University of Calgary in Alberta.

The CPCSSN data specific to the clinic were used to evaluate the lifestyle intervention. To be eligible for inclusion in the analysis, patients were required to have a weight measurement recorded in the EMR at least once both before and after the intervention. Women who were pregnant at any time during the study were excluded from the analysis.

Patient examination and laboratory data for weight, height, BMI, HbA$_{1c}$ level, and systolic and diastolic blood pressures were abstracted from the CPCSSN database along with patient age and sex. Relevant comorbidities (depression, hypertension, hyperlipidemia, and sleep apnea) were included, using text and ICD-9 searches in the encounter diagnoses, problem list, medication, and billing tables. Whether a patient had been assigned to a complex care plan (CCP) before March 31, 2010, was also included as a covariate. A CCP results from a formal agreement between a patient and his or her family physician relating to the goals of chronic disease care and the treatment implemented accordingly. Complex care plans are limited in application to patients who meet the qualifying criteria and are associated with additional payments to the physician in recognition of the more complex level and type of care.[14] Complex care plans were introduced to Alberta in 2009 and integrated into the index clinic shortly afterward.

Analysis

Patient averages for each outcome variable (weight, BMI, systolic and diastolic blood pressures, HbA$_{1c}$ level)

were calculated for the year before the intervention, as well as during the time period after the intervention. A change score was then calculated for each variable and a *t* test used to compare mean values between the control and intervention groups. Linear regression analysis was used to examine the associations with changes in health outcomes between groups, adjusting for age, sex, ethnicity, comorbidities, and CCP status.

RESULTS

Baseline characteristics

Electronic medical record data were available for 365 obese adults in the control group and 68 in the intervention group. The baseline characteristics of the 2 groups are shown in **Table 1**. Patient ethnicity was not recorded very frequently in the EMR and was excluded as a covariate in the analyses.

Changes in weight

Table 2 reports the average weight change in the intervention and control groups at the end of the study period. Patients who received the lifestyle intervention lost, on average, 0.81 kg (95% CI 0.62 kg gained to 2.23 kg lost). A similar amount of weight loss was also seen in the control group, with an average loss of 0.78 kg (95% CI 0.07 to 1.49 kg lost). The small difference in weight loss between groups was not statistically significant (*t* test, *P*=.98). The same result was found when using linear regression to compare weight outcomes between groups and adjusting for age, sex, comorbidities, and whether the patient had a CCP (linear regression, *P*=.84).

There were no overall differences in weight loss between women in the intervention and control groups, or between men in each group. However, men older than 65 years who received the lifestyle plan lost a mean of 3.02 kg more than men in the same age category in the control group (*P*=.008). No statistically significant differences were found in the younger (18 to 34 years) or middle-aged (35 to 64 years) patients of either sex.

Changes in secondary outcomes

There were minimal observable changes in BMI for either group (**Table 3**). Intervention patients had a mean BMI decrease of 0.06 kg/m^2 and control patients had a mean BMI increase of 0.15 kg/m^2. Differences in BMI change scores were not significantly different between the intervention and control groups (*t* test, *P*=.55), and this was consistent after using linear regression to adjust for age, sex, comorbidities, and whether the patient had a CCP (linear regression, *P*=.60).

Blood pressure outcomes for both groups are reported in **Table 3**. Patients receiving the lifestyle

Table 1. Baseline characteristics of patients in the year before the intervention (2007)

CHARACTERISTIC	CONTROL GROUP (N = 365)	INTERVENTION GROUP (N = 68)
Male sex, n (%)	177 (48.5)	47 (69.1)
Mean (SD) age, y	56.4 (12.7)	59.0 (12.8)
Ethnicity recorded, n (%)	105 (28.8)	9 (13.2)
Median (IQR) weight, kg	97.3 (18.2)	101.7 (18.6)
Median (IQR) body mass index, kg/m²	33.1 (5.3)	33.2 (5.5)
Mean (SD) systolic blood pressure, mm Hg	132.6 (11.2)	135.0 (11.6)
Mean (SD) diastolic blood pressure, mm Hg	79.8 (7.4)	80.8 (7.0)
Median (IQR) HbA_{1c} level, %	6.4 (1.2)	6.4 (1.0)
Complex care plan, n (%)	110 (30.1)	51 (75.0)
Depression, n (%)	90 (24.7)	12 (17.6)
Hypertension, n (%)	211 (57.8)	45 (66.2)
Hyperlipidemia, n (%)	99 (27.1)	9 (13.2)
Sleep apnea, n (%)	30 (8.2)	4 (5.9)

HbA_{1c}—glycated hemoglobin A_{1c}, IQR—interquartile range.

Table 2. Weight change from baseline (2007) to the end of the analysis period (2012) by age group and sex

	CONTROL GROUP			INTERVENTION GROUP			
CHARACTERISTIC	N	MEAN CHANGE,* KG	95% CI	N	MEAN CHANGE,* KG	95% CI	*P* VALUE
Men							
• All ages	177	0.26	-0.67 to 1.20	47	-0.50	-2.29 to 1.28	.45
• 18–34 y	8	8.46	0.09 to 16.83	2	5.17	-5.30 to 15.66	.67
• 35–64 y	116	0.03	-1.16 to 1.21	29	0.74	-1.89 to 3.38	.60
• ≥65 y	53	-0.45	-1.60 to 0.69	16	-3.47	-4.83 to -2.12	.008[†]
Women							
• All ages	188	-1.77	-2.82 to -0.71	21	-1.48	-3.99 to 1.03	.87
• 18–34 y	9	2.21	-4.18 to 8.59	1	2.80	NA	NA
• 35–64 y	129	-1.59	-2.97 to -0.21	13	-0.94	-4.56 to 2.68	.77
• ≥65 y	50	-2.93	-4.38 to -1.48	7	-3.11	-7.54 to 1.32	.93
Both sexes, all ages	365	-0.78	-1.49 to -0.07	68	-0.81	-2.23 to 0.62	.98

NA—not applicable.
*Positive mean change values indicate weight gain; negative mean change values indicate weight loss.
[†]Statistically significant.

Table 3. Change scores for secondary outcomes from baseline (2007) to the end of the analysis period (2012)

	CONTROL GROUP			INTERVENTION GROUP			
CHARACTERISTIC	N	MEAN CHANGE*	95% CI	N	MEAN CHANGE*	95% CI	*P* VALUE
Body mass index, kg/m²	309	0.15	-0.13 to 0.43	53	-0.06	-0.65 to 0.53	.55
Systolic blood pressure, mm Hg	364	-0.41	-1.41 to 0.58	67	-4.51	-7.13 to -1.89	.002[†]
Diastolic blood pressure, mm Hg	364	-1.45	-2.01 to -0.81	67	-3.12	-4.69 to -1.56	.04[†]
HbA_{1c} level, %	92	0.11	-0.07 to 0.28	25	-0.06	-0.40 to 0.27	.36

HbA_{1c}—glycated hemoglobin A_{1c}.
*Positive mean change values indicate an increase; negative mean change values indicate reduction.
[†]Statistically significant for unadjusted data.

intervention had a mean systolic blood pressure reduction of 4.51 mm Hg (95% CI 1.89 to 7.13 reduction) and a mean diastolic reduction of 3.12 mm Hg (95% CI 1.56 to 4.69 reduction) by the end of the study period. These reductions were greater than those in the control group (*t* test, *P*=.002 and *P*=.04, respectively), which had little or no reductions in mean systolic and diastolic blood pressures. After adjusting for age, sex, and hypertensive status through linear regression, the systolic blood pressure reduction maintained statistical significance (*P*=.01) but the diastolic blood pressure reduction became non-significant (*P*=.10).

Changes in HbA_{1c} level before and after the intervention were found to be negligible for both groups (**Table 3**). Control patients saw a mean increase of 0.11% compared with baseline levels; intervention patients had a mean decrease of 0.06%. No statistically significant differences in HbA_{1c} levels were observed between the 2 groups (*t* test, *P*=.36) and this was consistent after adjusting for age, sex, and whether the patient had a CCP (linear regression, *P*=.33).

DISCUSSION

Summary of results

The objective of this analysis was to determine whether patients who received a physician-developed lifestyle intervention lost weight compared with patients who received usual care. Overall, the intervention group did not lose more weight than the control group, with the exception of older men, in whom a substantial weight reduction was recorded. Another encouraging outcome was an improvement in systolic blood pressures. It is interesting to note that patients aged 18 to 34 years gained weight in both the control and intervention groups (an average of 5.15 kg and 4.38 kg, respectively). Young adults, in general, tend to see a greater rate of weight gain than other age groups,[15,16] and those living in rural communities are more at risk of becoming obese.[17] Other factors include differences in the approach that might have been taken by the index physician (a middle-aged man) in implementing the plan for patients of different ages and sexes. Paradoxically, the inclusion of a "no smoking" recommendation might have promoted weight gain for those attempting to quit and lessened the effect of the intervention. However, the intervention physician had given smoking cessation advice on a persistent basis and it was recognized by both patients and provider that weight gain could occur. Confounding attributable to these limitations is difficult to avoid or adjust for given the variable quality and quantity of data in the EMR. A larger sample of physicians and perhaps a supplementary patient survey would have been necessary to account for these factors.

Implications for primary care practices and research

The physician who implemented the intervention believed he had observed many patients achieving substantial weight loss by following the lifestyle recommendations, but sought empirical evidence to confirm that perception. A trade-off exists between the intensity and extensiveness of an intervention and its probable effect size. Studies of high-intensity interventions are at risk of limited external validity and generalizability if the intervention is enhanced beyond a level feasible in real-world circumstances.[3] Simpler interventions are feasible in such settings for patients struggling with complex medical issues, but these are less likely to measure desired outcomes. Using routinely collected EMR data for purposes of evaluation and research might mitigate these biases by providing objective perspectives on clinical activities and patient outcomes for large samples of patients of appropriate heterogeneity and homogeneity, over substantial periods of time, at reasonable cost.

The use of primary care EMR clinical data (apart from billing data) in Canada for the purposes of clinical evaluation and research is still in its early stages, despite having been a routine source of data in many countries for some time.[18] To drive forward clinical improvement and innovation, primary care research needs to be pragmatic, timely, accessible to clinicians, and not cost prohibitive. This analysis conforms to these requirements.

Limitations

Our research design was not randomized and did not involve close matching of control patients to individuals in the intervention group, but it is reflective both of typical clinical contexts and of patient behaviour in community-based primary care settings. Although EMR data present obvious advantages for clinical evaluation and primary care research, they are not without challenges. Behavioural data relevant to risk factors are frequently inconsistently recorded and would benefit from standardization. Because EMR use is a relatively recent activity in Canadian primary care, and owing to the complexities of EMR implementation, data recorded in the "early years" are often inconsistent and incomplete. For instance, only 68 obese patients were identified in the intervention physician's panel within the initial time period of the research. Currently, this physician cares for more than 300 obese patients. As one of the inclusion criteria was having at least one weight measurement in the year before the intervention, many obese patients were excluded from the study at the onset owing to missing weight data. This might have introduced bias into the results.

Several other limitations exist relating to the research design. Sample sizes in both groups were small, as only one clinic acted as the test site and only one physician's

patients within it made up the intervention group. Because this analysis was created in response to the interests of a single physician, the findings are meaningful to the index clinic, but are not directly generalizable to a wider population. In addition, there is a possibility of contamination between groups, as over the course of the intervention and the period after the intervention, physicians treating the control group might have learned about the lifestyle plan and adopted some or all recommendations for counseling their patients. However, this would facilitate a conservative estimate of the effectiveness of the intervention, which is arguably preferable. Finally, we assumed physicians in both groups provided a similar standard of care; this might not be the case and could have influenced patient outcomes. Ultimately, these limitations are the reality of pragmatic, real-world primary care research and are possibly unavoidable.

Conclusion

A simple lifestyle and dietary intervention distributed to obese patients by a family physician in community practice as part of routine clinical care was associated with significant weight loss in older men and a significant reduction in systolic blood pressure for all participants. These findings support the physician's observation that the intervention appeared to be beneficial, although the scale of advantage was less than the physician proposed. Health care innovation in routine primary care clinical practice is feasible and should be encouraged, but rigorous evaluation is important to understand the scale of the effects observed.

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Contributors
Ms Garies contributed to the assembly and analysis of data, drafted the manuscript, and handled revisions. Dr Irving developed and implemented the intervention and contributed to the study design and manuscript revisions. Dr Williamson developed the analysis plan and contributed to the study design and manuscript revisions. Dr Drummond contributed to the study design, analysis plan, and manuscript revisions.

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