Successful Implementation of the Exercise First Approach for Intermittent Claudication in the Netherlands is Associated with Few Lower Limb Revascularisations

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WHAT THIS PAPER ADDS

The ESC/ESVS guidelines recommend a supervised exercise therapy (SET) first strategy for management of intermittent claudication (IC). Revascularisation can be proposed, along with SET, if daily life activity is severely compromised. This study demonstrates that guideline adherence improved to 87% in Dutch patients with IC, probably as a result of optimised organisation of SET and greater awareness among healthcare providers. Revascularisation after primary SET was only necessary in 17% after five year follow up. These results support the feasibility of a SET first strategy in real world settings. Efforts should be made to make exercise accessible to all patients with peripheral artery disease.

Objective: A stepped care model, in which patients are primarily treated with supervised exercise therapy (SET), is recommended as the optimal strategy for intermittent claudication (IC). The aim of this study was to determine the primary treatment (SET, endovascular revascularisation [ER], or open surgery) in relation to secondary lower limb revascularisation and survival in patients with IC.

Methods: This study was a nationwide retrospective data analysis of health insurance claims of patients newly diagnosed with IC between January 2013 and December 2017. Exclusion criteria were the presence of diagnostic codes for critical limb ischaemia or for a diabetic foot. Study outcomes were distribution of primary treatment modalities, freedom from secondary lower limb revascularisation, and overall five year survival. Analysis included Kaplan–Meier method and Cox proportional hazards regression models with adjustment for multiple confounders (age, gender, socioeconomic status, use of diabetes medication, statins, platelet aggregation inhibitors or anticoagulants, presence of cardiac disease, chronic obstructive pulmonary disease, and pre-dialysis).

Results: The five year cohort included 54 504 patients with IC (primary SET $n = 39\,476$, primary ER $n = 11\,769$, and primary open surgery $n = 3\,259$). SET as primary treatment increased from 63% in 2013 to 87% in 2017. Patients who underwent ER or open surgery as a primary treatment had a higher risk of secondary revascularisations (hazard ratio [HR] 1.44; 95% confidence interval [CI] 1.37–1.51; $p < .001$ and HR 1.45; 95% CI 1.34–1.57; $p < .001$, respectively) and a higher mortality risk compared with SET as a primary treatment (HR 1.38; 95% CI 1.29–1.48; $p < .001$ and HR 1.49; 95% CI 1.34–1.65; $p < .001$, respectively).

Conclusion: Guideline adherence improved to 87% in Dutch patients with IC. Patients receiving primary SET had fewer lower limb revascularisations and demonstrated better survival than patients undergoing primary ER or open surgery.

Keywords: Conservative treatment, Exercise therapy, Guideline adherence, Intermittent claudication, Peripheral arterial disease, Survival
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INTRODUCTION

International guidelines on peripheral artery disease (PAD) recommend a stepped care model (SCM) as the optimal treatment strategy for intermittent claudication (IC). A SCM implies that endovascular treatment and surgery are restricted to patients who do not sufficiently benefit from

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supervised exercise therapy (SET). In addition, revascularisation can be proposed, alongside SET, if daily life activity is severely compromised.[1–3] However, implementation of SCM is hampered by suboptimal availability of specialised physiotherapists, referral patterns, and the lack of reimbursement for SET in most countries.[4,5] Ultimately, the chosen treatment is agreed upon in a shared decision making environment between the care provider and patient.

ClaudicatioNet was founded in 2011 in the Netherlands as a means to improve SCM adherence.[6] This unique nationwide network of specialised physiotherapists, vascular surgeons, and general practitioners (GPs) offers an innovative organisational structure that guarantees optimum accessibility and quality of SET for patients with IC. Previous studies analysed the economic impact of SCM implementation in the Dutch healthcare system using the data from one large health insurance company.[7,8] Compared with the year 2009, a 22% increase in SCM adherence was demonstrated in 2011, with 56% of patients with IC receiving SET as the primary treatment modality. This improved adherence was associated with 6% lower average costs of IC treatment per patient.

The current study is a collaboration of ClaudicatioNet and the National Health Care Institute (in Dutch: Zorginstituut Nederland), which is a public organisation that assesses quality, accessibility, and cost effectiveness of healthcare in the Netherlands, and advises the Dutch Ministry of Health, Welfare and Sport. This extensive evaluation will contribute to the "Appropriate Care" project (in Dutch: Zinnige Zorg), which aims to improve the implementation of the SCM in IC treatment to reduce the number of unnecessary invasive interventions and related healthcare costs.[9] It was hypothesised that higher rates of SCM adherence over a five year time period would result in lower rates of lower limb revascularisations. Additionally, this study aimed to determine whether there were differences in overall survival after different primary treatment methods.

MATERIALS AND METHODS

This study was performed according to the STROBE Statement.[10]

Health insurance is obligatory for all Dutch residents. Therefore, healthcare activities related to a diagnosis or treatment mandatorily result in healthcare claims. This study was a retrospective analysis of three national claims databases, namely:

- ZPD database (Healthcare Performance and Declarations), which encompasses all reimbursement data from all Dutch health insurance companies, including hospital based data and community care based data (i.e. care provided by physiotherapists and general practitioners [GPs]). The mortality data were also retrieved from this database. Source: National Healthcare Institute, data provided by Vektis (data warehouse).
- DIS database (DBC Information System), which incorporates claims data for hospital based healthcare. Source: National Healthcare Institute, data made available by Dutch Healthcare Authority (NZA).
- GIP database (Medicine Information Project), which assembles data on medication use. Source: National Healthcare Institute/GIP.

The combination of these three databases resulted in an accurate compilation of all accorded claims on diagnostic and therapeutic care in all Dutch patients with IC within the selected timeframe. The National Health Care Institute is a public organisation that has legal basis and permission for conducting analyses on the databases used in this study. Hence, additional approval from a medical ethical committee was not requested.

Eligibility criteria

Patients were included if they were diagnosed and treated for IC (i.e. symptomatic PAD Fontaine stage II or Rutherford stages 1—3), defined as the combination of symptomatic PAD specific diagnostic codes, Doppler ultrasound and/or imaging codes (duplex ultrasound, CT angiography, MR angiography), and treatment codes (SET, endovascular revascularisation, or open surgery). The analysis was restricted to data that had entered the databases between January 2013 and December 2017. Data in national claims databases are obtained retrospectively, which can cause a delay of up to three years. This phenomenon results from administration issues. Therefore, the analysed data of 2016 and 2017 were 90% and 80% complete, respectively. The authors considered these datasets including 2017 reliable and sufficiently complete, as the limited number of missing data was random and proportional. Only patients newly diagnosed with IC were eligible, defined as the absence of diagnostic or therapeutic care claims data related to IC in the three years prior to 2013. Exclusion criteria were the presence of the diagnostic codes for critical limb ischaemia or for diabetic foot. (See the Supplementary material to this article for in depth argument on the choices made regarding the methodology of this study.)

Definition of groups and specific outcomes

Patients meeting the inclusion criteria were divided into three groups based on primary treatment claims:

- SET group: community based SET as primary treatment.
- ER group: endovascular revascularisation (ER) including percutaneous transluminal angioplasty with or without stenting as primary treatment.
- OS group: open surgery (OS) including bypass surgery and endarterectomy as primary treatment.

A secondary intervention was defined as lower limb revascularisation following primary treatment and included secondary ipsilateral intervention, primary contralateral intervention, and revision of OS. The available data did not

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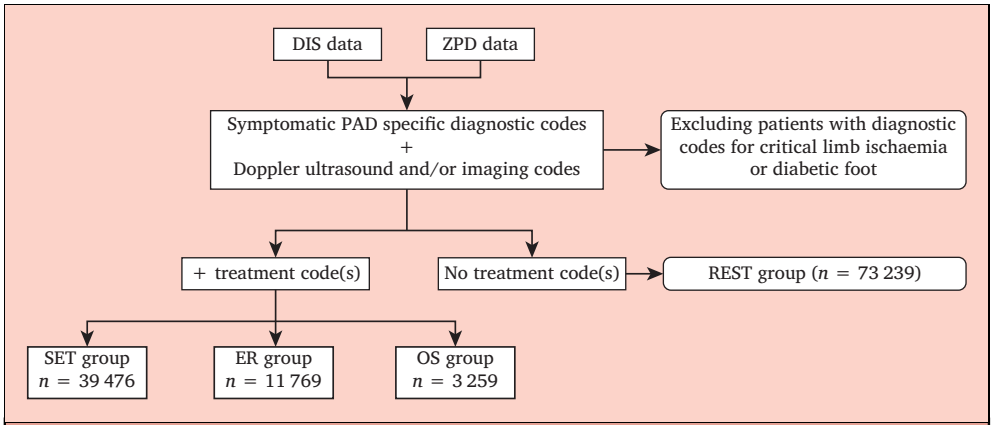

Figure 1. Flowchart of defined groups of patients with intermittent claudication treated by supervised exercise therapy (SET), endovascular revascularisation (ER), or open surgery (OS) between 2013 and 2017 in the Netherlands based on national claims databases DIS and ZPD. The REST group consists of patients lacking treatment codes. PAD = peripheral artery disease.

allow for further differentiation between these three groups. According to this definition, a secondary intervention for the SET group was a first revascularisation, whereas it was a second revascularisation for the ER and OS groups.

SET programme

SET typically contains up to 37 individual sessions of 30 min during a three to 12 month period. The main part of the programme consists of treadmill based or track based exercise until the patient experiences claudication symptoms of moderate severity. An exercise—rest—exercise cycle is repeated several times per session.

Outcome measures

The study objectives were to determine: the relative distribution of SET, ER, and OS as the primary treatment for patients with IC between 2013 and 2017; the freedom from secondary interventions according to the primary treatment over a five year period; and the overall survival following the primary treatment over a five year period.

Data analysis

Patient characteristics were compared using one way analysis of variance (ANOVA) for continuous variables and the chi square test for categorical variables. Freedom from secondary interventions and overall survival were assessed using the Kaplan—Meier method. The follow up period was set at five years post-intervention. Patients without a secondary intervention were censored at the end of the study period or at death. For overall survival, patients were censored at the end of the study. The log rank test was used to compare survival of groups according to the primary treatment. A p value $< .01$ was considered statistically significant. Cox proportional hazards regression models were used to analyse the association between primary treatment and time to event outcomes (secondary intervention or death) in unadjusted and adjusted models. Results were summarised as hazard ratio (HR) estimates with associated 95% confidence intervals (CI). The potential confounders included in the multivariable regression analyses were pre-selected based on the literature, a previous pilot study[11] analysing claims of a large Dutch health insurance company, and availability of the variables in the claims databases. These confounders were age, gender, socioeconomic status based on postal codes (SES; low, middle, and high tertiles), use of diabetes medication, statins, platelet aggregation inhibitors, or anticoagulants (vitamin K antagonists, direct thrombin inhibitors, and direct factor Xa inhibitors; excl. heparin), the presence of cardiac disease (acute or chronic heart failure, stable or unstable angina pectoris, ST segment elevation myocardial infarction [STEMI] and non-STEMI), chronic obstructive pulmonary disease (COPD), and pre-dialysis (eGFR < 30 mL/min). Descriptive statistics were used to determine the other objectives. The number of missing values was expected to be very limited, given the type of data used. As results are therefore not influenced, only complete case analysis was performed. Statistical analysis was performed using SAS Enterprise Guide 6.1.

RESULTS

The full study cohort included 54 504 patients treated for IC (see Fig. 1). Additionally, this study identified a large REST group in which 73 239 patients had a Doppler ultrasound and/or imaging, but treatment codes were absent. Patients in this REST group either had no diagnosis of PAD, or were diagnosed as having PAD but were left untreated, or were diagnosed as having PAD but received alternative treatment (e.g. “walking advice”). As no further details about these patients could be retrieved from the claims database, this REST group was excluded from analysis as predefined by the study criteria (see Supplemental material for extra information).

Patient characteristics and potential confounders are summarised in Table 1 according to their primary

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Table 1. Characteristics of patients with intermittent claudication according to primary treatment by supervised exercise therapy (SET), endovascular revascularisation (ER), or open surgery (OS) between 2013 and 2017 in the Netherlands

	SET (n = 39 476)	ER (n = 11 769)	OS (n = 3 259)
Age − y	70 ± 10[*,†]	66 ± 10[†]	68 ± 10
Male	22 833 (58)[*,†]	7 165 (61)[‡]	2 361 (72)
Low socioeconomic status	17 055 (43)[*,†]	5 450 (46)	1 536 (47)
Use of diabetes medication	9 968 (25)[*,†]	2 653 (23)	735 (23)
Use of statins	31 769 (80)[*,†]	9 822 (83)	2 765 (85)
Use of platelet aggregation inhibitors or anticoagulants	34 263 (87)[*,†]	10 945 (93)	3 027 (93)
Cardiac disease	11 698 (30)[*,†]	3 693 (31)[†]	1 167 (36)
COPD	3 803 (10)[*,†]	1 525 (13)[†]	477 (15)
Predialysis	795 (2)	213 (2)	71 (2)

Data are presented as n (%) or mean ± standard deviation. p values are based on one way ANOVA for continuous variables and chi-square test for categorical variables. COPD = chronic obstructive pulmonary disease.
* $p < .010$ for SET *vs.* ER.
† $p < .010$ for SET *vs.* OS.
‡ $p < .010$ for ER *vs.* OS.

treatment. The mean age was 69 years and 59% were male. Compared with the ER and OS groups, the SET group was two to four years older, included more female patients, and more patients using diabetes medication. Furthermore, use of statins, platelet aggregation inhibitors, and anticoagulants was significantly lower in the SET group, and cardiac disease and COPD were less prevalent. The mean length of follow up was three years. Missing data were limited to potential confounders with a maximum of 1.9%.

Distribution of primary treatment modalities

SET was the primary treatment in the vast majority of patients, with a total of 39 476 patients (72%), followed by ER (22%) and OS (6%). Comparison of the years 2013 and 2017 revealed an upward trend of SET as primary treatment from 63% to 87% (Fig. 2).

Freedom from secondary interventions for IC

The Kaplan—Meier estimates for the freedom from secondary interventions after five year follow up were 0.8267 (standard error [SE] 0.002) for patients having SET as their primary treatment, 0.7371 (SE 0.005) for ER, and 0.7432 (SE 0.009) for OS (Fig. 3). This means that the estimated need for secondary interventions within five years was 17 of 100 patients after primary SET and 26 of 100 patients for ER and OS. The mean time between primary and secondary intervention was 7 months after primary SET, 6.1 months after ER, and 6.5 months after OS. This analysis included re-interventions done within 30 days of the primary revascularisation, namely in 348 patients (3%) after primary ER and in 66 patients (2%) after primary OS. Patients who underwent ER as primary treatment sustained a higher risk of secondary interventions than those in the SET group, both in the unadjusted Cox regression model (HR 1.58; 95% CI 1.50—1.65; $p < .001$) and the adjusted model (HR 1.44; 95% CI 1.37—1.51; $p < .001$). This was also true for patients who had undergone OS as primary treatment compared with SET

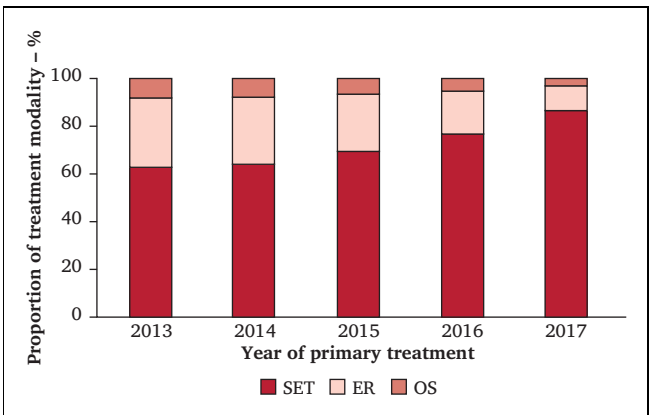

Figure 2. Distribution of primary treatment modalities, supervised exercise therapy (SET), endovascular revascularisation (ER), and open surgery (OS), for intermittent claudication in 2013—2017 in the Netherlands.

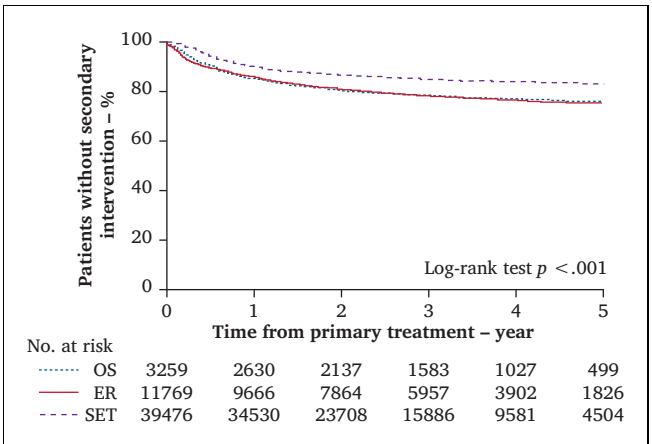

Figure 3. Cumulative Kaplan—Meier estimate of freedom from secondary intervention according to primary treatment supervised exercise therapy (SET), endovascular revascularisation (ER) and open surgery (OS), for intermittent claudication in 2013—2017 in the Netherlands. The graph reflects the first revascularisation after SET and the second revascularisation for the ER and OS groups.

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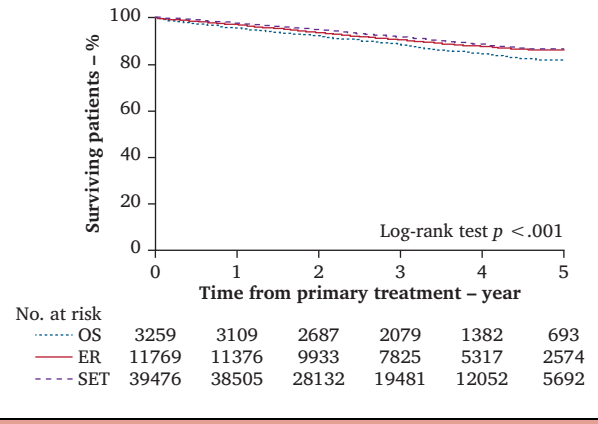

Figure 4. Cumulative Kaplan–Meier estimate of overall survival according to primary treatment supervised exercise therapy (SET), endovascular revascularisation (ER), and open surgery (OS), for intermittent claudication in 2013–2017 in the Netherlands.

in the unadjusted model (HR 1.55; 95% CI 1.44–1.68; $p < .001$) and the adjusted model (HR 1.45; 95% CI 1.34–1.57; $p < .001$). Univariable and multivariable analyses are presented in Tables S1A and S1B in the Supplementary results.

Overall survival

The Kaplan–Meier estimates for overall survival after five year follow up were 0.8622 (SE 0.003) for patients who had received SET as the primary treatment, 0.8593 (SE 0.004) for ER, and 0.8187 (SE 0.009) for OS (Fig. 4). This means that an estimated 14 of 100 patients with primary SET or primary ER died within five years, and an estimated 18 of 100 for primary OS. ER as primary treatment was associated with a higher mortality risk compared with SET in the unadjusted Cox regression model (HR 1.12; 95% CI 1.04–1.19; $p = .001$), as well as in the adjusted model (HR 1.38; 95% CI 1.29–1.48; $p < .001$). The higher mortality risk was also found for OS compared with SET in both the unadjusted model (HR 1.43; 95% CI 1.29–1.58; $p < .001$) and the adjusted model (HR 1.52; 95% CI 1.37–1.68; $p < .001$). Univariable and multivariable analyses are presented in Tables S2A and S2B in the Supplementary results.

DISCUSSION

This retrospective study of reimbursement data provides a unique insight into real world nationwide treatment data of 54 504 Dutch patients with IC over a five year time period. Over time, the guideline adherence to a "SET first" approach improved to 87%. Interestingly, the five year freedom from revascularisation was 83% in the primary SET group. Overall, the patients who received SET as primary treatment underwent fewer lower limb revascularisations and had a better five year survival than those who were treated by primary revascularisation.

The gradually improved SCM adherence is probably not an automatic consequence of the SET first approach class I recommendation.[1,2] Despite abundant evidence supporting the benefits of SET, such programmes are widely underused in most countries.[12] Lack of reimbursement and poor patient compliance contribute to this suboptimal participation.[4,5,13,14] The current study reports on the results of IC treatment in a country with sufficient SET availability. Accessibility is optimised through a nationwide organisation of community based SET provided by specialised physiotherapists as organised by ClaudicatioNet.[6] Increased awareness of referring physicians also contributed to improved SET referral rates, and offering SET as a fully fledged treatment modality probably decreases patient reluctance to participate.[15] That 37 sessions of SET have been fully reimbursed since 2017 through basic health insurance (whereas SET was previously only reimbursed through optional supplementary health insurance policies), is likely to have further stimulated programme participation. Overall, a combined adequate organisation of SET and greater awareness have improved SCM adherence in the Netherlands. Although it is understandable that many researchers focus on alternative treatment options in case of low SET accessibility, their endeavours should not result in a negligence to improve SET organisation.

A 100% primary SET rate is not realistic. This is also captured in the guideline recommendations, as primary revascularisation can be proposed if daily life activity is severely compromised.[1,2] A report from the National Health Care Institute concluded that the number of unnecessary invasive interventions needed to be reduced, based on outdated data.[9] For example, vascular surgeons have been reluctant to prescribe SET in case of cardiopulmonary comorbidity or aorto-iliac disease.[15] The current study demonstrates successful SCM implementation. Moreover, a primary SET rate of >80% is feasible. Ideally, limited SET accessibility should not be a factor for favouring revascularisation. Moreover, primary revascularisation should be provided along with SET according to the recommendations. In this study population, only a dismal 10% received SET in the first year following ER or OS. This finding introduces a new focus for improvement, as enhancing physical capacity should always be included in IC treatment as this is an essential part of cardiovascular risk management.

The current study shows that a "revascularisation first" strategy in IC was associated with a high risk of secondary lower limb revascularisations. Two recent meta-analyses concluded that there was no significant difference in the number of secondary revascularisations at 12 month follow up in patients who underwent either an endovascular treatment or SET.[16,17] These seemingly discrepant findings are possibly explained by the current study analysing claims data without handling commonly used exclusion criteria regarding comorbidity and lesion specific characteristics, such as unilateral disease or level of disease. In addition, the substantial difference in follow up (12 months *vs.* five years) probably contributed to these different study results. Importantly, it was not possible to correct for severity of atherosclerosis, a limitation that can contribute to the observed differences in revascularisation rates. However, it is important to realise that PAD is a manifestation of

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atherosclerosis resulting in systemic disease. Improved long term effectiveness is possibly explained by revascularisation being a focal therapy, whereas SET provides systemic benefits.[18,19]

PAD is associated with increased risk of cardiovascular and all cause mortality.[20,21] According to the literature, the five year mortality for patients with IC is 10–15%, although these studies may be dated.[1,22,23] Nevertheless, the mortality rate in this large contemporary cohort is quite similar, suggesting that the efficacy of or adherence to current medications may be limited. As indicated by the medication use in this cohort, there might still be some room for improvement regarding the use of statins (81%) and platelet aggregation inhibitors or anticoagulants (89%).[1,2] Moreover, morbidity and mortality risks could possibly be reduced by promoting positive health behaviour. There is abundant evidence on the importance of modifiable risk factors by adapting a healthy lifestyle. A factor that is particularly relevant in patients with IC is physical activity.[19,24,25] To optimise results, lifestyle counselling should play a more central role in IC treatment.

Interestingly, better survival was found in the SET group compared with ER and OS groups. A recent meta-analysis[16] of studies with up to seven years follow up found no difference in all cause mortality when comparing endovascular treatment with SET. On the contrary, the five year survival analysis in the current study revealed a survival benefit for those who received SET. However, as it was not possible to adjust for several important determinants of survival in the present claims dataset, such as smoking status and ankle brachial index, these data should be interpreted cautiously. It is possible that SET has a protective effect because of the potential beneficial effects on cardiovascular risk, morbidity, and mortality.[19] Similar benefits of exercise based rehabilitation are already well known in cardiac rehabilitation, and SET specific evidence is expanding.[26] An optimal IC treatment strategy should focus on relieving IC symptoms and reducing cardiovascular risk, and should aim for a durable effect.

Limitations

This retrospective analysis has limitations as the analysed data were restricted to the available national claims. Most importantly, it was not possible to correct for severity of PAD (i.e. walking distance and ankle brachial indices), which is a potential confounder for all reported outcomes. Additionally, variables such as cigarette smoking and physical activity level, factors known to be associated with overall mortality, also were not available. Because these confounders were not included in the multivariable analysis, it is uncertain whether the observed difference in overall mortality was associated with the primary treatment or caused by residual confounding. In case of a secondary intervention, it was not possible to differentiate between a secondary ipsilateral intervention, a primary contralateral intervention, or a revision of OS. In addition, therapy adherence to SET was unknown. Furthermore, this study could not report results on walking distance and quality of life. However, SET and ER are equally effective in this regard based on current literature.[16,17,27] Also, it was not possible to identify combination therapy as a treatment modality. Notably, this upcoming treatment modality of invasive therapy combined with SET is not yet included in the treatment recommendations. Therefore, it is uncertain whether combination therapy was present in the current dataset. As stated in the Results section, a large REST group was excluded from analyses. As claims data were used, it was impossible to retrieve any specifics regarding the patients in this group other than that they were not treated by SET or revascularisation. Despite the restrictions mentioned, this cohort study represents the outcomes of commonly used interventions in a large number of typical patients with IC delivered within the context of routine care, in contrast to many trials that offer little insight into adapting treatments in a real world setting.[28]

Conclusion

SCM adherence improved to 87% in Dutch patients with IC between 2013 and 2017. Approximately 83% of patients in the primary SET group remained free of revascularisation for up to five years of follow up. Additionally, a new focus for improvement was identified. As a disappointingly low 10% received SET in the first year following primary revascularisation, although considered standard care according to the recommendations, future endeavours should be directed towards increasing this rate of participation.

CONFLICTS OF INTEREST

J.A.W. Teijink is the co-founder and chairman of ClaudicatioNet, a charitable foundation with no financial benefits for its founders or board members. The other authors have no conflicts of interest to declare.

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None.

APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejvs.2020.07.074.

REFERENCES

1 Aboyans V, Ricco JB, Bartelink MEL, Björck M, Brodmann M, Cohnert T, et al. Editor's choice - 2017 ESC guidelines on the diagnosis and treatment of peripheral arterial diseases, in collaboration with the European society for vascular surgery (ESVS). *Eur J Vasc Endovasc Surg* 2018;**55**:305–68.

2 Gerhard-Herman MD, Gornik HL, Barrett C, Barshes NR, Corriere MA, Drachman DE, et al. 2016 AHA/ACC guideline on the management of patients with lower extremity peripheral artery disease: executive summary: a report of the American college of cardiology/American heart association task force on clinical practice guidelines. *Circulation* 2017;**135**:e686–725.

3 Layden J, Michaels J, Bermingham S, Higgins B. Diagnosis and management of lower limb peripheral arterial disease: summary of NICE guidance. *BMJ* 2012;**345**:e4947.

4 Popplewell MA, Bradbury AW. Why do health systems not fund supervised exercise programmes for intermittent claudication? *Eur J Vasc Endovasc Surg* 2014;**48**:608–10.
5 Gommans LN, Teijink JA. Attitudes to supervised exercise therapy. *Br J Surg* 2015;**102**:1153–5.
6 Hageman D, Van Den Houten MML, Spruijt S, Gommans LNM, Scheltinga MRM, Teijink JAW. Supervised exercise therapy: it does work, but how to set up a program? *J Cardiovasc Surg* 2017;**58**:305–12.
7 Fokkenrood HJ, Scheltinga MR, Koelemay MJ, Breek JC, Hasaart F, Vahl AC, et al. Significant savings with a stepped care model for treatment of patients with intermittent claudication. *Eur J Vasc Endovasc Surg* 2014;**48**:423–9.
8 Hageman D, Fokkenrood HJP, Essers PPM, Koelemay MJW, Breek JC, Vahl AC, et al. Improved adherence to a stepped-care model reduces costs of intermittent claudication treatment in The Netherlands. *Eur J Vasc Endovasc Surg* 2017;**54**:51–7.
9 Dutch National Healthcare Institute. *Room for Improvement Analysis: peripheral artery disease*. 2016. Available from: https://english.zorginstituutnederland.nl/publications/reports/2018/05/30/room-for-improvement-analysis-claudication-intermittent-zinnige-zorg. [Accessed June 2020].
10 von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol* 2008;**61**:344–9.
11 Achmea. Beslisdocument Uitkomstindicatoren Perifeer Arterieel Vaatlijden. Achmea Zorg & Gezondheid. *Kwaliteit Van Zorg. Internal communication document*. December 2013.
12 Treat-Jacobson D, McDermott MM, Bronas UG, Campia U, Collins TC, Criqui MH, et al. Optimal exercise programs for patients with peripheral artery disease: a scientific statement from the American heart association. *Circulation* 2019;**139**:e10–33.
13 Makris GC, Lattimer CR, Lavida A, Geroulakos G. Availability of supervised exercise programs and the role of structured home-based exercise in peripheral arterial disease. *Eur J Vasc Endovasc Surg* 2012;**44**:569–75. discussion 76.
14 McDermott MM. Exercise rehabilitation for peripheral artery disease: a review. *J Cardiopulm Rehabil Prev* 2018;**38**:63–9.
15 Hageman D, Lauret GJ, Gommans LNM, Koelemay MJW, van Sambeek M, Scheltinga MRM, et al. Supervised exercise therapy for intermittent claudication is increasingly endorsed by Dutch vascular surgeons. *Ann Vasc Surg* 2018;**47**:149–56.
16 Fakhry F, Fokkenrood HJ, Spronk S, Teijink JA, Rouwet EV, Hunink MGM. Endovascular revascularisation versus conservative management for intermittent claudication. *Cochrane Database Syst Rev* 2018;**3**:CD010512.
17 Pandey A, Banerjee S, Ngo C, Mody P, Marso SP, Brilakis ES, et al. Comparative efficacy of endovascular revascularization versus supervised exercise training in patients with intermittent claudication: meta-analysis of randomized controlled trials. *JACC Cardiovasc Interv* 2017;**10**:712–24.
18 Lane R, Harwood A, Watson L, Leng GC. Exercise for intermittent claudication. *Cochrane Database Syst Rev* 2017;**12**:CD000990.
19 Jansen SCP, Hoorweg BBN, Hoeks SE, van den Houten MML, Scheltinga MRM, Teijink JAW, et al. A systematic review and meta-analysis of the effects of supervised exercise therapy on modifiable cardiovascular risk factors in intermittent claudication. *J Vasc Surg* 2019;**69**:1293–308. e2.
20 Golomb BA, Dang TT, Criqui MH. Peripheral arterial disease: morbidity and mortality implications. *Circulation* 2006;**114**:688–99.
21 Criqui MH, Aboyans V. Epidemiology of peripheral artery disease. *Circ Res* 2015;**116**:1509–26.
22 Criqui MH, Langer RD, Fronek A, Feigelson HS, Klauber MR, McCann TJ, et al. Mortality over a period of 10 years in patients with peripheral arterial disease. *N Engl J Med* 1992;**326**:381–6.
23 Weitz JI, Byrne J, Clagett GP, Farkouh ME, Porter JM, Sackett DL, et al. Diagnosis and treatment of chronic arterial insufficiency of the lower extremities: a critical review. *Circulation* 1996;**94**:3026–49.
24 Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. The physical activity guidelines for Americans. *JAMA* 2018;**320**:2020–8.
25 Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren M, et al. European guidelines on cardiovascular disease prevention in clinical practice (version 2012). The fifth joint task force of the European society of cardiology and other societies on cardiovascular disease prevention in clinical practice (constituted by representatives of nine societies and by invited experts). *Eur Heart J* 2012;**33**:1635–701.
26 Fletcher GF, Landolfo C, Niebauer J, Ozemek C, Arena R, Lavie CJ. Promoting physical activity and exercise: JACC health promotion series. *J Am Coll Cardiol* 2018;**72**:1622–39.
27 Murphy TP, Cutlip DE, Regensteiner JG, Mohler ER, Cohen DJ, Reynolds MR, et al. Supervised exercise versus primary stenting for claudication resulting from aortoiliac peripheral artery disease: six-month outcomes from the claudication: exercise versus endoluminal revascularization (CLEVER) study. *Circulation* 2012;**125**:130–9.
28 Glasgow RE, Lichtenstein E, Marcus AC. Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *Am J Public Health* 2003;**93**:1261–7.

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