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ORIGINAL RESEARCH ARTICLE

A Guideline-Implementation Intervention to Improve the Management of Low Back Pain in Primary Care: A Difference-in-Difference-in-Differences Analysis

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Abstract

Background Real-world adherence to clinical practice guidelines is often poor, resulting in sub-standard patient care and unnecessary healthcare costs. This study evaluates the effect of a guideline-implementation intervention for the management of low back pain (LBP) in general practice–the Fear Reduction Exercised Early (FREE) approach—on LBP-related injury insurance claims, healthcare utilisation, and costs of treatment.

Design Data were extracted from comprehensive nationwide New Zealand injury insurance claims records. Data were analysed using a 'triple-difference' (difference-in-difference-in-differences) method to isolate the causal effect of FREE training on LBP claims activity, comparing the difference in general practitioner (GP) LBP claims and associated activity before and after training with their non-musculoskeletal injury claims for the same periods (assumed to be unaffected by training), relative to the same comparisons for GPs not trained in the FREE approach.

Results Training GPs in the FREE approach resulted in significant reductions in the number of LBP injury claims lodged (− 19%, 95% CI −34 to −5), the use of physiotherapy (−30%, 95% CI − 42 to − 18) and imaging (− 27%, 95% CI − 46 to − 8%), and the healthcare costs (− 21%, 95% CI − 41 to − 1) of LBP injury. Changes in claims for earnings' compensation (− 10%, 95% CI − 34 to 13) were not significant.

Conclusions A brief guideline-implementation intervention following best-practice LBP management and guideline-implementation strategies achieved significant reductions, persisting over at least 6 to18 months, in healthcare utilisation consistent with improved delivery of guideline-concordant care.

Key Points for Decision Makers

Adherence to clinical guideline recommendations for the management of low back pain in primary care is poor, despite clear international consensus on optimal treatment.

We found that a brief training intervention developed to address known barriers to effective implementation reduced unnecessary healthcare use and healthcare costs of managing low back pain.

Tailored, context-specific implementation strategies should be used to improve the use of clinical practice guidelines.

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1 Introduction

Low back pain (LBP) is the leading cause of disability and health loss worldwide, affecting more than 500 million people at any point in time and is responsible for more than 60 million years lived with disability in 2019 [1, 2]. It imposes considerable costs on individuals, health system funders, and societies, particularly through reduced productivity and absence from work and due in part to an over-reliance on medically intensive treatment approaches that deliver relatively low benefit [3–6]. There is a pressing need for evidence-based, cost-effective, and context-specific strategies to reduce the LBP burden.

There is clear international consensus on best-practice primary care treatment and management of LBP [7], but a substantial gap exists between guideline recommendations and actual practice [7, 8]. Guideline-recommended care emphasises a biopsychosocial view of back pain, recognising the association between behavioural, psychological, and social factors in the experience of, and recovery from, pain. Self-management, physical activity, and psychological therapies are recommended ahead of pharmacological or surgical interventions [7, 9, 10]; imaging is not recommended in the absence of specific 'red flags' indicating potential serious disease [7]. Despite these recommendations, current practice commonly involves an overuse of opioid medications for pain relief, inappropriate spinal imaging, and potentially harmful interventional procedures, including surgery [3, 7]. Key barriers to effective implementation of best-practice recommendations include clinicians' beliefs about the causes and optimal treatment of LBP, inadequate knowledge of and confidence in best-practice management, patient expectation of interventional treatment, and inadequate time to provide high-value personalised care [7, 11–13].

The Fear Reduction Exercised Early (FREE) approach to LBP was designed to empower and support general practitioners (GPs) to provide effective guideline-concordant care for LBP in routine clinical practice [14]. It provides information, support, and guidance for GPs to implement evidence-based care in accordance with guideline recommendations, encouraging activity and work participation, integrating a biopsychosocial approach, and discouraging interventions with low beneficial value and potential risk of harms. It was designed to explain the rationale and evidence for current guideline recommendations and to overcome key barriers to their effective implementation [15]. The Fear Reduction Exercised Early includes brief (5 hours) GP education and training, resources to support patients with education, advice, and reassurance, and electronic consultation support to encourage adherence to guideline-recommended management [14].

The FREE approach was evaluated in a pragmatic cluster-randomised controlled trial (RCT), which found that training GPs in the FREE approach had a substantial positive impact on GPs' knowledge, attitudes, and confidence to deliver best-practice care for LBP and improved alignment with guideline recommendations, over a 6-month follow-up [16]. Economic evaluation suggested reductions in unnecessary healthcare utilisation and healthcare costs, but results were uncertain due to the short follow-up period, inherent wide variability in healthcare costs, and the limited sample size of the RCT [16]. In this study, we evaluate the effect of training GPs in the FREE approach on injury insurance claims, healthcare utilisation, and costs over longer-term follow-up (33 months), using routinely collected insurance claims data for a larger cohort of GPs trained in both the RCT and a concurrent implementation study.

2 Methods

2.1 Data Sources

Both the RCT and the implementation study were conducted in the Greater Wellington region of New Zealand (NZ). General practitioners were recruited for the studies through practices or direct approach via primary healthcare organisations. All GPs working in practices in the primary study region (Hutt Valley) were invited to participate in either the RCT or the implementation study. Additional GPs from secondary implementation areas (Wellington City, Kāpiti, and Wairarapa) were invited to the sample for the implementation study to add diversity in the study population (e.g., rural practice, migrant health, indigenous Māori health, and older adult care). Training was conducted between July 2016 and April 2018.

Data used in this study were obtained from routine insurance claims records held by the Accident Compensation Corporation (ACC), NZ's universal national no-fault insurance scheme for personal injury and the primary funder of LBP health care in NZ. Data were extracted from the ACC claims database by month (relative to date of training) for 36 months before and 33 months after training for all consenting FREE-trained GPs in both the RCT and the implementation study, and by calendar month between July 2013 (36 months before the first FREE training date) and December 2020 (33 months after the last training date) for all GPs nationwide not involved in FREE training during either study. Data from the FREE-trained GPs (collected by month relative to the specific training date) were mapped to the nearest calendar month to form the combined dataset for analysis: for training dates on or before the 15th of the month, the first month's data were matched to the calendar month of training; for training dates on or after the 16th

of the month, the first post-training month was matched to the following calendar month (e.g., for a GP trained on 25 August 2017, the first post-training month, representing claims lodged between 26 August and 25 September, was aligned with calendar month data for non-trained GPs for September 2017).

2.2 Outcome Measures

For each month, all LBP injury claims made during that month were identified (see Table C1 in Appendix C in Online Resource 1 for the list of codes used). For each claim, associated activity was calculated over a 6-month period following the index claim date (i.e., the most recent data cover activity up to June 2021, for claims lodged in December 2020). In the ACC system, all activity associated with a given injury event is recorded against the initial claim (and thus included in the data used in this study), regardless of the healthcare provider referring for or delivering the service. Outcome measures calculated were the total number of LBP injury claims per month, the number of healthcare visits paid on those claims (GP visits, imaging, physiotherapy, other allied and complementary health services, and specialist consultations), the cost of claims (total costs including healthcare costs, vocational rehabilitation, and earnings' compensation payments; and healthcare costs only), the number of claims for which earnings compensation was paid and the total number of days of earnings compensation paid, the number of subsequent LBP insurance claims made by the same patients (lodged by either the original GP or any other healthcare provider), and the number of non-musculoskeletal injury claims (used as a control measure as described below). All costs are reported in 2018 NZ dollars (NZ$), adjusted using NZ Consumer Price Index inflation rates [17] (in 2018, 1 NZD ≈ 0.70 USD). All data were observed at the GP-month level of the original claim (i.e., all claims lodged by a given GP in a given month, and their associated outcomes).

2.3 Statistical Analysis

To identify causal effects of providing FREE training to GPs, we used a triple-difference design exploiting three sources of variation in exposure to the effects of training [18]. First, we used data from pre-training (over 36 months prior to each GP's individual training date) and post-training periods (claims over 33 months after the training date, with subsequent activity for each claim recorded over the following 6 months). Second, we used the number of non-musculoskeletal injury claims for each GP to serve as a control for time-varying changes in GPs' overall level of activity, contrasted with the LBP claims measures. Third, we used claims made by non-FREE-trained GPs as a control for variation in national practice patterns or activity unrelated to FREE training, contrasted with the data on claims made by FREE-trained GPs. Full details of the triple-difference model are provided in Appendix A (in Online Resource 1). Validation of the modelling assumptions of the triple-difference model, including event study figures to assess the plausibility of the parallel trends assumption (Figs B1 and B2), are provided in Appendix B (in Online Resource 1).

Our primary model provides estimates of the average effect of FREE training over the full 33-month follow-up period. To investigate the persistence of effects, we also calculated effect estimates for 6-month periods (1–6 months, 7–12 months, etc., post-training) and, for graphical presentation of results, for each month 1, …, 33 following training. We estimated effects using a generalised linear model (GLM), with a log link and quasi-Poisson (for count outcomes) or gamma (for cost outcomes) variance function. For interpretation, we report the average treatment effects (on the treated: the mean difference, per FREE-trained GP over the follow-up period, between observed LBP claims/healthcare visits/costs and predicted outcomes if they had not received FREE training) alongside the coefficient estimates.

2.3.1 Sensitivity Analyses

We conducted several robustness checks on our model specification and sample selection assumptions. First, we excluded GPs practising in the Greater Wellington region (the region in which FREE training was implemented) from the national GP cohort, to exclude possible 'spill-over' effects of training (for example, through local professional networking). Second, we re-ran the analyses using only data on claims lodged up to 18 months post-training (or prior to September 2019, 18 months after the last FREE training date, for the non-FREE-trained cohort). In March 2020 (i.e., within the 6-month follow-up period of claims lodged in September 2019), NZ entered a strict nationwide lockdown in response to the COVID-19 pandemic, resulting in a sharp discontinuity in ACC claims activity and other healthcare utilisation, which may impact our results for later periods. Third, we excluded observations (GP-months) with abnormally high numbers of either LBP or non-musculoskeletal claims (more than 10 LBP or 100 non-musculoskeletal injury claims in a month), as these outlying values may have a disproportionate impact on our estimated results (these high volumes were considered unlikely to represent routine general practice and may indicate practitioners working in acute care settings such as after-hours or urgent care clinics). Fourth, we excluded all claims lodged in the last 6 months before training for all FREE-trained GPs. Outcomes were recorded over the 6 months following the original index claim date; outcomes measured against these late pre-training claims may therefore have been affected by FREE

training. Fifth, we aggregated the monthly data extracted from claims records to the quarterly level, to reduce the sparsity of the data for rare outcomes. Lastly, we estimated models allowing for linear time trends in each outcome and for each study cohort. Full details of the rationale and specification of each sensitivity analysis are reported in Appendix B in Online Resource 1.

3 Results

3.1 Descriptive Statistics

Sixty-three GPs (from 8 practices) took part in the RCT, of whom 58 were trained in the FREE approach (34 GPs in the intervention group; 24 of the 29 GPs in the control group received the intervention following completion of RCT data collection in their practices), and a further 123 GPs (43 practices) in the implementation study (all of whom received training). Of the 181 GPs trained in the FREE approach, 175 (97%) consented to the use of their insurance claims data in the study; 7 had no relevant claims over the study period or could not be linked with claims records, resulting in 168 FREE-trained GPs included in the analysis. Baseline descriptive statistics of GP characteristics and injury claims activity are reported in Table 1. The average age was 47 years, and slightly more than half were female. Comparable data were not available for the non-FREE-trained cohort used in this study; compared to the nationwide average for practising GPs (53 years and 50% female in 2017 [19]), the FREE-trained cohort was slightly younger and had a slightly higher proportion of women. The GPs had been in practice for an average of 16 years at the time of training.

Over the 3 years prior to training, FREE-trained GPs lodged an average of 31 ACC claims for LBP, incurring total claims costs of $19,900 (per GP). The most common healthcare referrals on LBP claims were to physiotherapy (49 visits per GP) and other allied health providers (21 visits).

The national cohort of GPs not trained in the FREE approach (N = 6075) had higher claims numbers (LBP and non-musculoskeletal), healthcare utilisation, and costs, largely due to a small number of GPs with extremely

Table 1 Descriptive statistics of GP cohorts

Outcome	FREE-trained cohort		Non-trained cohort	
N	168		6075	
GP characteristics				
Age, years	47.4 (11.2)			
Gender, *n* (%) female	94 (56%)			
Length in practice, years	15.9 (11.6)			
	Pre-training	Post-training	Pre-training	Post-training
LBP claims				
Number of LBP claims	30.7 (25.6)	27.4 (22.2)	42.6 (111.7)	39.2 (110.5)
Number of healthcare visits on LBP claims				
GP	17.4 (19.5)	17.5 (18.8)	32.1 (87.8)	31.1 (88.8)
Physiotherapy	49.1 (47.0)	35.9 (34.4)	68.7 (171.3)	59.2 (162.5)
Imaging	6.8 (7.7)	5.8 (5.5)	10.5 (24.4)	10.4 (25.8)
Allied health	21.3 (26.5)	24.3 (29.5)	65.2 (307.1)	64.0 (295.6)
Specialist consultations	3.3 (4.5)	2.9 (5.1)	6.3 (17.2)	6.3 (18.5)
Cost of LBP claims				
Total	$19,946 ($25,108)	$21,941 ($23,646)	$33,730 ($93,669)	$36,232 ($109,738)
Medical fees	$6210 ($7677)	$5843 ($6178)	$13,126 ($36,211)	$12,881 ($37,359)
Earnings' compensation on LBP claims				
Number of claims receiving earnings' compensation	1.9 (2.4)	2.0 (2.4)	3.0 (8.9)	3.0 (10.0)
Total days earnings' compensation	99 (146)	111 (136)	160 (476)	171 (561)
Claims subsequent to LBP claims				
Number of subsequent claims	0.8 (5.0)	0.5 (1.0)	1.6 (6.0)	1.4 (6.0)
Number of non-MSK claims filed	169.0 (192.9)	172.0 (294.3)	333.6 (1647.3)	300.1 (1598.6)

Values are mean (standard deviation) unless otherwise stated. GP characteristics as at date of training. Injury claims data collected over 33 months before and after training date for FREE-trained GPs; 33 months before and after the median training date (November 2017) for non-trained GPs. Baseline GP characteristics were not available for the non-trained cohort

FREE Fear Reduction Exercised Early approach (intervention), *GP* general practitioner, *LBP* low back pain, *MSK* musculoskeletal injury

high levels of activity (see the large standard deviations in Table 1, and Figs C1 and C2 in Appendix C in Online Resource 1). As noted above, these observations with abnormally high volumes were considered unlikely to represent routine general practice. Excluding these outlying observations (GP-months with more than 10 LBP claims or 100 non-musculoskeletal claims), the baseline numbers of claims, healthcare utilisation, and costs were much more similar in the FREE-trained and non-trained cohorts (Table B2 in Appendix B in Online Resource 1; excluding these months from our analyses did not meaningfully change any of our main results).

3.2 Primary Results

Our primary triple-difference estimates of the effects of FREE training are presented in Table 2. There was a large and statistically significant reduction in the number of LBP injury claims filed over 33 months post-training (− 8.1 claims per GP [equivalent to a 19% reduction]; 95% CI − 15.7 to − 0.4), and in the number of visits to physiotherapy (− 18.9 visits [− 30%]; 95% CI − 30.9 to − 6.9) and imaging (− 2.7 visits [− 27%]; 95% CI − 5.2 to − 0.1). Reductions were also seen in the number of specialist consultations (− 1.3 visits [− 27%]; 95% CI − 3.0 to 0.3), although these were statistically significant only in the first 6 months following training. There was no significant reduction in the number of LBP claim-funded visits to GPs (− 3.3 visits [− 13%]; 95% CI − 8.9 to 2.2) or allied health services other than physiotherapy (− 1.0 visits [− 3%]; 95% CI − 8.5 to 6.5).

There were also substantial reductions in both total claims costs (− $5 486 [− 18%]; 95% CI − 13,924 to 2951) and healthcare treatment costs (− $1852 [− 21%]; 95% CI − 4053 to 350). For total claims costs, this reduction was statistically significant only in the first 6 months after training, while reductions in medical fees costs were significant up to 18 months post-training. Effects on the number of claims receiving earnings' compensation (− 0.3 claims [− 10%]; 95% CI − 1.0 to 0.4) and on the total days of earnings compensation paid (− 21 days [− 13%]; 95% CI − 70 to 28) were generally not significant, except for a marginally significant reduction in the number of claims for which the patient received earnings compensation in the first six months after training only. There was a very large proportional reduction in the number of subsequent LBP claims lodged (for the same patients, by any healthcare provider; − 0.5 claims [− 47%]; 95% CI − 1.5 to 0.4); however, as the number of subsequent claims over the 6-month follow-up period was small, these estimates were very imprecise.

Estimates of the intervention effect by time since training are shown graphically in Fig. 1 (for the outcomes with significant effects in Table 2; see Fig. C3 in Appendix C in Online Resource 1 for all other outcomes). Intervention effects generally decreased in magnitude over the 2 years following training; there was a later increase in effects on most outcomes starting from around 18–24 months post-training, but this was subject to wide uncertainty intervals.

3.3 Sensitivity Analyses

Our primary results were robust to all sensitivity analyses considered. Full results from all sensitivity analyses are presented in Appendix B in Online Resource 1.

4 Discussion

Improving adherence to best-practice care for LBP in primary care has proven persistently challenging despite clear and consistent guideline recommendations [3, 7]. Key implementation barriers that need to be overcome to realise effective implementation of guideline-concordant care include clinicians' and patients' beliefs about the causes and treatment of LBP, lack of knowledge and confidence in managing LBP among GPs, and patient expectations for medical intervention [7, 11–13]. This study reports on the evaluation of a guideline-implementation intervention designed specifically to overcome these barriers and demonstrates large and sustained changes in GP behaviour and reductions in healthcare utilisation for LBP following a brief training intervention.

Our estimate of the reduction in LBP injury claims filed over 33 months (19%) is consistent with previously reported results (over 6 months) from the RCT (in the trial, 54% of consultations with FREE-trained GPs were linked to ACC claims compared to 69% of consultations with non-trained GPs, a 22% reduction). The FREE approach emphasises that LBP can occur without injury and that framing it as an injury risks unnecessarily medicalising LBP and may have negative consequences on the patient's perception of fragility and willingness to return to physical activity. This result likely indicates that trained GPs became less willing to ascribe LBP to injury (as required to lodge an ACC claim), and more confident that patients would recover without additional treatment (and therefore saw less need to support patients with an ACC claim).

The primary mechanism through which the FREE approach is expected to impact patient care and costs of treatment is by changing GP behaviour with respect to referral of patients to other health services; much of this additional care is considered medically unnecessary, wasteful, and, especially in the case of imaging and some specialist referrals for surgical intervention, potentially harmful [7]. Consistent with this expectation, we found substantial and statistically significant reductions in the number of visits to physiotherapy, imaging, and specialist consultations, but

Table 2 Triple-difference estimates of change in LBP claims activity following FREE training

Outcome	(1) Regression coefficients	(2)	(3)	(4)	(5)	(6)	(7) Average treatment effect (per GP over 33 months)
	Full 33-month follow-up period	Months 1–6	Months 7–12	Months 13–18	Months 19–24	Months 25–30	
Panel A. LBP claims							
Number of LBP claims	− 0.22 (0.09)**	− 0.20 (0.06)***	− 0.27 (0.08)***	− 0.14 (0.08)*	− 0.18 (0.09)*	− 0.23 (0.13)*	− 8.1 (− 15.7 to − 0.4)
Panel B. Number of healthcare visits							
GP	− 0.14 (0.11)	− 0.16 (0.09)*	− 0.12 (0.12)	− 0.09 (0.12)	− 0.05 (0.14)	− 0.14 (0.16)	− 3.3 (− 8.9 to 2.2)
Physiotherapy	− 0.37 (0.09)***	− 0.56 (0.09)***	− 0.42 (0.11)***	− 0.39 (0.09)***	− 0.24 (0.12)**	− 0.18 (0.15)	− 18.9 (− 30.9 to − 6.9)
Imaging	− 0.32 (0.13)**	− 0.56 (0.12)***	− 0.39 (0.14)***	− 0.26 (0.15)*	− 0.14 (0.17)	− 0.23 (0.18)	− 2.7 (− 5.2 to − 0.1)
Allied health	− 0.04 (0.12)	− 0.12 (0.16)	− 0.22 (0.19)	− 0.04 (0.13)	0.24 (0.17)	− 0.08 (0.18)	− 1.0 (− 8.5 to 6.5)
Specialist consultations	− 0.32 (0.18)*	− 0.59 (0.21)***	− 0.14 (0.24)	− 0.25 (0.23)	− 0.16 (0.28)	− 0.35 (0.23)	− 1.3 (− 3.0 to 0.3)
Panel C. Cost of claims							
Total	− 0.21 (0.13)	− 0.37 (0.16)**	− 0.15 (0.17)	− 0.25 (0.20)	− 0.01 (0.21)	− 0.14 (0.20)	− $5 583 (− $14 201 to $3 035)
Medical fees	− 0.26 (0.12)**	− 0.33 (0.19)*	− 0.29 (0.15)*	− 0.33 (0.14)**	− 0.06 (0.18)	− 0.22 (0.16)	− $1 881 (− $4 126 to $364)
Panel D. Earnings compensation							
Number of claims receiving earnings' compensation	− 0.11 (0.13)	− 0.24 (0.14)*	0.07 (0.14)	− 0.14 (0.21)	− 0.09 (0.18)	− 0.03 (0.21)	− 0.3 (− 1.0 to 0.4)
Total days earnings' compensation	− 0.15 (0.15)	− 0.28 (0.18)	− 0.07 (0.20)	− 0.33 (0.25)	0.08 (0.23)	− 0.02 (0.24)	− 21 (− 70 to 28)
Panel E. Subsequent claims							
Number of subsequent claims	− 0.64 (0.41)	− 0.50 (0.39)	− 0.74 (0.44)*	− 0.33 (0.50)	− 0.61 (0.50)	− 1.05 (0.54)*	− 0.5 (− 1.5 to 0.4)

Periods defined by the date of the index LBP claim; associated healthcare visits, costs, and subsequent claims calculated over 6 months from index claim date

All regressions include non-parametric controls for all two-way interactions (injury type-by-time period, cohort-by-time period, injury type-by-cohort)

Standard errors, clustered at the GP level, are shown in parentheses. *p* values: *** < 0.01 < ** < 0.05 < * < 0.1

Average treatment effects reported with 95% confidence intervals in parentheses

FREE Fear Reduction Exercised Early approach (intervention), *GP* general practitioner, *LBP* low back pain

no significant reduction in the number of funded visits to GPs for LBP. These results suggest that GPs have increased confidence in their own abilities to effectively manage LBP patients, and are consistent with qualitative and quantitative findings from the prior implementation study. There was no significant change in the use of allied health services other than physiotherapy; utilisation of these services is commonly driven by prior patient experience and beliefs rather

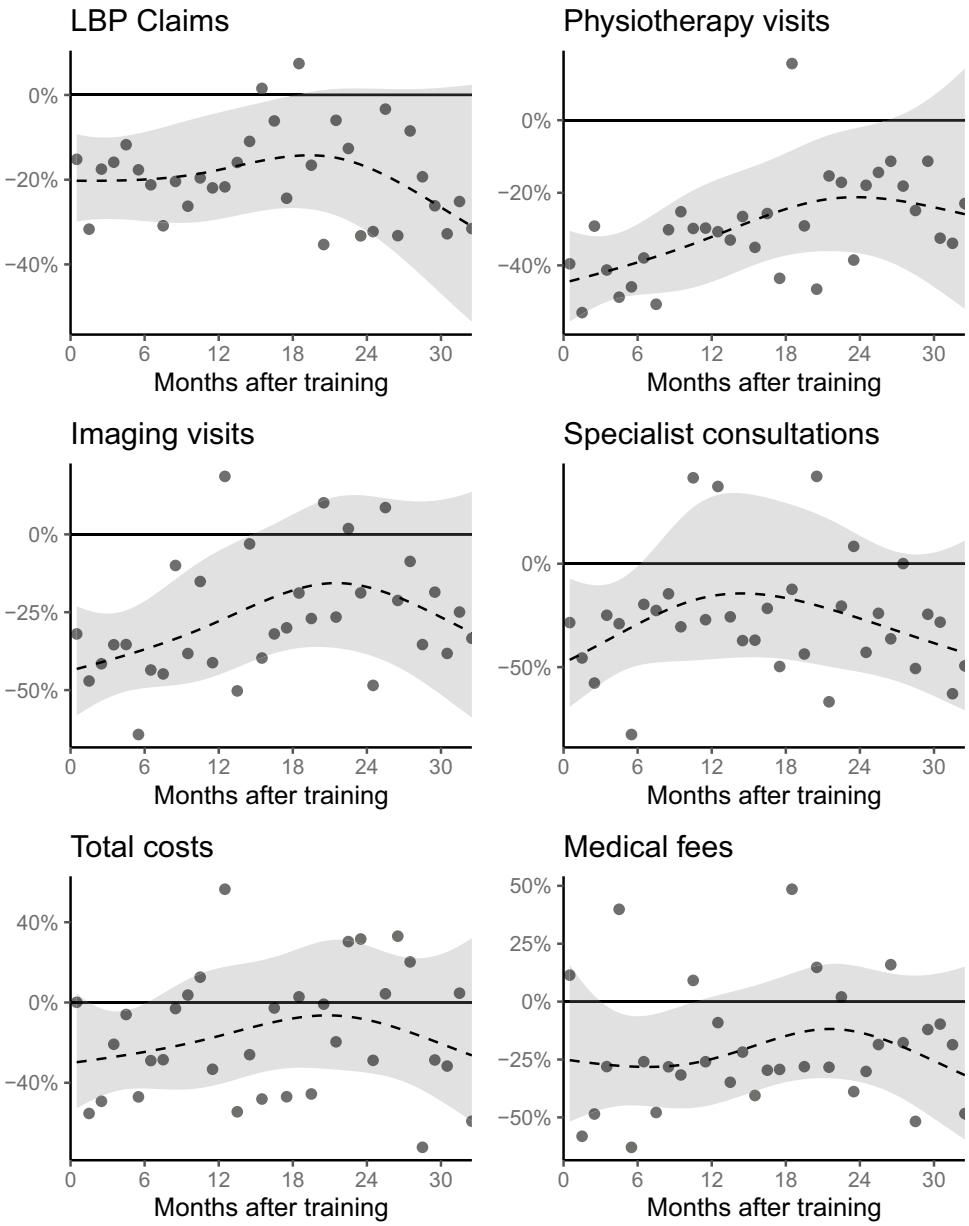

Fig. 1 Trajectory of triple difference estimates of effect of FREE training. Each dot represents the month-specific treatment effect estimate. Smoothed curve and confidence band (representing 95% confidence intervals) from cubic spline smoothing function. *FREE* Fear Reduction Exercised Early approach (intervention)

than GP recommendation [20, 21], and may therefore be less amenable to GP-level intervention.

Repeated episodes of LBP are very common, although patients may or may not seek care for any given episode. Guideline recommendations and the FREE approach aim to help clinicians and patients to reduce the perceived need for medical intervention to manage LBP and to develop peoples' skills and confidence to effectively self-manage their LBP, thereby reducing the demand for future healthcare for LBP. This is supported by the very large reductions found in this study in the number of subsequent claims lodged (although these were imprecisely estimated due to the small number of subsequent claims lodged over the 6-month follow-up period).

Given the high prevalence, burden, and costs of LBP globally, and ongoing use of ineffective and potentially harmful treatments, there is a clear need to improve LBP management from both an economic and health perspective. Evidence from the previous RCT of the FREE approach indicates that this training intervention was able to achieve changes in GP beliefs and behaviour, improvements in the delivery of guideline-concordant care, and patient outcomes comparable to those of usual care [16]. The results of the present study further suggest that FREE training resulted in measurable and meaningful impacts on healthcare use and costs over the medium-term in a real-world care setting. Although GPs were reimbursed for attending the training workshop and for the first three consultations undertaken

during the training period, no subsequent incentives or encouragement were provided to achieve uptake and adherence in routine practice. Process evaluation undertaken in the RCT found that LBP consultations by FREE-trained GPs were longer than those by non-trained GPs; this does not appear to have prevented sustained behaviour change, suggesting that GPs saw benefits in delivering guideline-concordant care after training in the FREE approach and that the tools provided were able to support this activity. It is not known whether FREE consultations became shorter as GPs became more experienced with the approach, or whether they continued to allocate more time to these consultations despite not receiving any extra funding to do so.

This study is subject to several limitations. There was a relatively small number of GPs trained in the RCT and implementation study phases, resulting in wide uncertainty around our estimates, particularly for less common outcomes (such as earnings' compensation or subsequent LBP claims). Despite being rare occurrences, these outcomes contribute a large share of the total costs of LBP. Further research with a larger sample size will be needed to assess possible effects on these outcomes.

Our findings are limited to LBP covered by ACC. The ACC system covers all work-related back pain, and non–work-related back pain attributable to injury, occurring within NZ, with universal no-fault coverage of the entire population; however, no data were available in this study on patients consulting their GP for non–work-related LBP that was not attributed to an injury event (i.e., not covered by ACC). Our results may not be generalisable to LBP not covered by ACC (or comparable compensation and insurance schemes in other health care systems), as ACC coverage may influence the way in which patients seek healthcare and how their LBP is managed (due to the increased resources available to fund investigations and treatment). We also have no data on any costs of care not covered by ACC. While most injury-related care is covered by ACC, there are additional out-of-pocket costs (co-payments and non-covered items) incurred by patients for some primary and community-provided care. For non–work-related injury, the first 5 days of absence from work is usually covered by the employee's sick leave and is not represented in ACC data.

General practitioners who self-selected into study participation and completed training may be more open to change in their management of LBP than other GPs who did not select into training, questioning the generalisability of these results to the wider workforce. This possibility should be mitigated by two factors. First, uptake of training and study participation was high: 82% of GPs in the primary study area attended FREE training. Second, many GPs were recruited and trained within practices, so even GPs who may not have individually selected into training would likely complete the training if their practice was involved in the study. Nevertheless, these results should be viewed as applying to a cohort at least nominally willing to engage with changes in their clinical practice to deliver more guideline-concordant LBP care.

4.1 Implications for Policy and Practice

Our results, and the findings from the previous RCT and implementation study, suggest that a brief GP training intervention can effectively improve the management of LBP in primary care. These findings support previous studies suggesting a need for tailored guideline-implementation strategies to overcome known, context-specific barriers to effective guideline adherence in clinical practice [12, 15]. Key barriers to delivery of guideline-concordant care for LBP in the NZ primary care system were identified in development of the FREE approach through literature review, interviews with both GPs and people with LBP, a national survey, and pilot testing of the intervention. Achieving change in the behaviour of both GPs and patients was supported by evidence-based behaviour change techniques; education and training increased GPs' knowledge of and confidence in applying LBP clinical practice guidelines; electronic consultation support was provided to facilitate use of the FREE approach in routine practice; and an information booklet and website for both patients and GPs provides clear, accessible, and easily understood evidence-based information on recommended LBP management and outcomes [16, 22].

The potential return on investment for healthcare funders of successful implementation of LBP clinical practice guidelines is substantial. The cost of providing the brief training intervention evaluated in this study was approximately $1025 per GP (Table C2 in Appendix C in Online Resource 1), compared with estimated healthcare cost savings of $1852 and total claims cost savings of $5486 over 33 months. There are potential additional implementation costs and considerations in adaptation of the approach for other countries and health systems. General practitioner consultations in NZ are generally about 15 minutes in duration, longer than in other comparable health systems; the feasibility and potential cost of the longer consultations required to deliver the FREE approach would need to be considered in other health systems. There is also a need for the (one-off) development of the electronic consultation support tool and its integration with existing practice management systems. There may be ongoing costs of printing and distributing the patient information booklets, although an electronic version is available.

Previous systematic reviews have found that implementation interventions need to be ongoing and regular to generate sustained changes in clinical practice [12]. In this study, we found a brief (half-day) training intervention was able to deliver sustained changes over a 33-month follow-up;

however, effects on most outcomes were strongest over the first 6–18 months, suggesting a possible role for refresher sessions to reinforce long-term behaviour change and potentially further strengthen intervention cost effectiveness. We suggest future guideline implementation interventions consider the optimal use of refresher sessions or other strategies to enhance long-term adherence and cost effectiveness.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40258-022-00776-3.

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Author Contributions Conceptualisation: BD, JS, SD, JHA, FM, AD conceptualised and developed the FREE approach; RW, YP, BD, JHA conceptualised the data collection and analysis reported in this article. Formal analysis: RW. Funding acquisition: BD, JS, SD, JHA, FM, AD. Methodology: BD, RW, YP, JHA. Project administration: BD, AD, SG. Visualisation: RW. Writing—original draft: RW. Writing—review & editing: YP, JHA, SD, JS, SG, FM, AD, BD.

Declarations

Conflicts of interest The authors declare that they have no conflict of interest.

Ethics approval and trial registration The RCT and implementation study providing data for this study were registered with the Australia New Zealand Clinical Trial Registry (Trial IDs ACTRN12616000888460 and ACTRN12616000896471, respectively) and approved by the New Zealand Central Region Health and Disability Ethics Committee (16/CEN/43 and 16/CEN/77).

Consent to participate All FREE-trained GPs whose data were used in the study gave consent for their study data to be linked to ACC claims records for the purpose of this study. Claims data for GPs not trained in the FREE approach were extracted by ACC from their database, anonymised, and shared with the research team; GP consent was not required for this audit activity.

Consent for publication Not applicable.

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Data availability The data used in this study are proprietary and are held by the Accident Compensation Corporation (ACC), but may be made available to interested researchers with the explicit permission of the ACC.

Code availability All analysis code used in this study is available on request from the authors.

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