Study protocol_7 Oct 2019

TITLE

Evaluating audit and feedback for reducing musculoskeletal diagnostic imaging requests by high-requesting Australian general practitioners: protocol for a factorial cluster randomised trial

INVESTIGATORS

Dr Denise O'Connor
Prof Rachelle Buchbinder
Prof Chris Maher
Prof Kirsten McCaffery
Dr Adrian Traeger
Dr Loai Albarqouni
Dr Juliet Checketts
Ms Parima Vyas
A/Prof Laurent Billot
Ms Brigit Maguire
Mr Brett Clark
Prof Paul Glasziou

BACKGROUND

Regional musculoskeletal conditions such as low back, neck, shoulder, hip, knee and foot pain are common and are significant contributors to global disability.[1] General practitioners (GPs) are often the first clinical contact for people presenting with musculoskeletal conditions.[2,3] Evidence-based primary care guidelines for many of these conditions generally recommend against early diagnostic imaging in the absence of features suggestive of a specific and/or serious underlying cause or unexplained progression of symptoms. This is because diagnostic imaging for these conditions is unlikely to provide meaningful information to guide management, carries risk of iatrogenic harm for patients (e.g., exposure to ionising radiation for some investigations; identification of incidental findings that may lead to further unnecessary care) and wastes valuable healthcare resources.[4-7] Despite this, overuse of diagnostic imaging for people with musculoskeletal conditions by GPs persists.[8-12]

Audit and feedback is one widely used strategy for improving professional practice and involves measuring and feeding back a summary of clinical performance to healthcare providers over a specified period of time. A Cochrane review of 140 randomised trials found that audit and feedback results in a median 4.3% absolute improvement in healthcare provider adherence to desired practice, although the effects are highly variable across conditions, settings and design of interventions (ranging from a 9% decrease to a 70% increase).[13] Cumulative analysis of trial findings demonstrates the median effect of audit and feedback became stable in 2003 after 30 trials and that newer studies have contributed little in terms of how to optimise effects.[14] For example, only 12% of trials in the Cochrane audit and feedback review directly compare different ways of designing or delivering audit and feedback and only 9% incorporate potential effect modifiers that theory suggests would improve its impact.[13,15,16]

Meta-regression from the Cochrane review suggests providing feedback on more than one occasion is associated with increased effects.[13,14] Furthermore, theories that seek to explain how audit and theory works suggest that multiple instances of audit and feedback are inherent to the 'feedback cycle'[17] and encourage a 'feedback loop'.[18] In anticipation of future receipt of new performance data, recipients may be motivated to take action to reduce discrepancies between current and desired practice. On receipt of new performance data presented over time, recipients also have the opportunity to observe the impact of any behavioural changes.

The way in which feedback data is displayed has also been identified as a potential effect modifier. A recent paper on optimising audit and feedback informed by empirical and theoretical knowledge suggests the feedback display should attract and maintain the attention of recipients on relevant information and in a manner that highlights key recommendations.[15] Clinical Performance Feedback Intervention Theory (CP-FIT) also highlights the importance of the feedback display and asserts that feedback is more likely to be effective when it employs user-friendly designs which minimise cognitive load and helps recipients decide what aspects of their performance requires attention.[17]

To our knowledge, only five randomised trials have evaluated audit and feedback interventions to address overuse of musculoskeletal diagnostic imaging by GPs and these have had mixed effects.[19-23] None have compared different ways of designing or delivering audit and feedback based on current empirical and theoretical knowledge for maximising its effect.[24]

RESEARCH PLAN

Aims

1. To estimate the effectiveness of audit and feedback for reducing diagnostic imaging requests for 11 musculoskeletal imaging services (low back CT, low back x-ray, neck CT, neck x-ray, neck MRI, shoulder x-ray, shoulder ultrasound, hip x-ray, hip ultrasound, knee x-ray, ankle/hind foot ultrasound) in high-requesting GPs in Australia compared with control.
2. To evaluate which forms of feedback are most effective in reducing musculoskeletal diagnostic imaging requests and to estimate their effects.

Hypotheses

1. That audit and feedback will result in a greater reduction in diagnostic imaging request rate compared to control.
2. That enhanced feedback delivered on two occasions will result in a greater reduction in diagnostic imaging request rate compared to standard feedback delivered on one occasion.

Study design

The design of the trial will be a 5-arm factorial cluster randomised controlled trial. GPs will be randomly allocated to receive either no feedback intervention (control) or feedback. Within those allocated to feedback, GPs will be first randomly allocated to feedback on one or two occasions (Factor 1) and then standard or enhanced feedback display (Factor 2).

Study setting
General practices and included GPs, located in any state or territory of Australia.

Participant eligibility and recruitment
Inclusion criteria
GPs practising in Australia will be eligible if they are in the top 20% of GP requesters for 11 targeted musculoskeletal diagnostic imaging services and in the top 20% of requesters for at least 4 individual items. The targeted diagnostic imaging are: 1) low back CT, 2) low back x-ray, 3) neck CT, 4) neck x-ray, 5) neck MRI, 6) shoulder x-ray, 7) shoulder ultrasound, 8) hip x-ray, 9) hip ultrasound, 10) knee x-ray, 11) ankle/hind foot ultrasound. Only diagnostic imaging requests that lead to a service being rendered by a radiologist and for which a Medicare Benefits Schedule (MBS) claim is made are in scope.

Exclusion criteria
GPs will be excluded if they:

1. have less than 1000 Category 1 services within the 12-month period of 1 January 2018 to 31 December 2018;
2. they did not make any in-scope musculoskeletal diagnostic imaging requests within the 12-month period of 1 January 2018 to 31 December 2018;
3. have participated in user testing of the intervention;
4. are currently or have been involved in a Department of Health compliance activity within the past 12 months.

Randomisation and allocation concealment
General practices, with at least one eligible GP, will be simultaneously randomised either to no intervention control or to one of four intervention groups at baseline. The randomisation sequence will be generated using a computer-generated randomisation algorithm in the statistical program R. GPs will be clustered based on exact-matched primary practice addresses. Randomisation of general practices will be stratified by geographic region (urban, regional/rural-remote: Modified Monash Model (MMM) 1, MMM 2-7).

Blinding
Trial participants will not be blinded to group allocation but the risk of performance bias is considered to be minimal as GPs will not be aware of the variations of audit and feedback being tested nor the outcome measures and analytical approach. Analyses will be independently conducted by two statisticians using randomly shuffled group allocations. Real allocations will only be revealed once analyses are completed and agreement between the two statisticians is reached.

Interventions
GPs will be allocated to a control group (Group 1) or one of four intervention groups.

All GPs allocated to an intervention group will receive feedback on their diagnostic imaging request rate for 11 musculoskeletal imaging services compared with the request rate of their GP peers. The targeted diagnostic imaging are: 1) low back CT, 2) low back x-ray, 3) neck CT, 4) neck x-ray, 5) neck MRI, 6) shoulder x-ray, 7) shoulder ultrasound, 8) hip x-ray, 9) hip ultrasound, 10) knee x-ray, 11) ankle/hind foot ultrasound.

Group 2 will receive feedback delivered by mail on one occasion (at month 0) that illustrates (i) in graphical format, the GP's overall diagnostic imaging request rate per 1000 consultations compared with his/her GP peers over the previous calendar year (January to December 2018), and (ii) in tabular format, the GP's request rate per 1000 consultations for each musculoskeletal imaging service compared with his/her GP peers over the previous calendar year.

Group 3 will receive feedback as described in Group 2, but supplemented with highlighted text in the table designed to draw the GP's attention to those musculoskeletal imaging services where they are in the top 20% of requesters.

Group 4 will receive feedback as described in Group 2, but supplemented with feedback on a second occasion (at month 9-12) illustrating (i) in graphical format the GPs' overall diagnostic imaging request rate per 1000 consultations compared with his/her GP peers over the six month period following the first letter and previous calendar year; and (ii) in tabular format, the GP's request rate per 1000 consultations for each musculoskeletal imaging service compared with his/her GP peers over the six month period following the first letter.

Group 5 will receive feedback as described in Groups 3 and 4.

Outcomes

Primary outcome

Rate of diagnostic imaging requests for each GP per 1000 Category 1 services for the targeted 11 musculoskeletal imaging services that are rendered by a radiologist over the 12 months following randomisation using Medicare Benefits Schedule (MBS) data. Targeted diagnostic imaging (DI) services are: 1) Low back CT, 2) Low back x-ray, 3) Neck CT, 4) Neck x-ray, 5) Neck MRI, 6) Shoulder x-ray, 7) Shoulder ultrasound, 8) Hip x-ray, 9) Hip ultrasound, 10) Knee x-ray, 11) Ankle/hind foot ultrasound.

Secondary outcomes

1. Rate of diagnostic imaging requests for each GP per 1000 Category 1 services for the targeted 11 musculoskeletal imaging services that are rendered by a radiologist using MBS data at 6 and 18 months after randomisation.
2. Rate of low back CT requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
3. Rate of low back x-ray requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
4. Rate of neck CT requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
5. Rate of neck x-ray requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
6. Rate of neck MRI requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
7. Rate of shoulder x-ray requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
8. Rate of shoulder ultrasound requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.

9. Rate of hip x-ray requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
10. Rate of hip ultrasound requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
11. Rate of knee x-ray requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
12. Rate of ankle/hind foot ultrasound requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.
13. Rate of ankle x-ray requests for each GP per 1000 Category 1 services using MBS data at 6 and 18 months after randomisation.

Ankle x-ray is not a targeted diagnostic imaging services but is a possible substitute for ankle/hind foot ultrasound so it will be included as a secondary outcome to check for switching.

Baseline data collection
The following baseline data will also be collected: age, gender, geographical location of primary practice address (metropolitan vs. regional/rural/remote) and rates of musculoskeletal diagnostic imaging requests for primary and secondary outcomes at baseline.

Power
We expect to randomise a total of 3,820 general practitioners from 2,271 general practices. 1,444 practices will comprise one provider only with the remainder including between 2 and 12 providers. To be conservative, the sample size calculation assumes 2,271 clusters of size one.

The primary endpoint will be the rate of diagnostic imaging requests for each GP per 1000 Category 1 services. A sample size of 2,271 general practices will be randomised 4:1 between the intervention and control arms. This will provide >90% power to detect a difference as small as 1.2 requests in the average rate of diagnostic imaging requests. This calculation assumes a standard deviation of 7 and a two-sided type-I error rate of 5%.

This sample size will also provide >90% power to detect a difference of 1.2 requests in the average rate of diagnostic imaging requests between general practices receiving feedback on one occasion (n=908) vs. two occasions (n=908) and between those receiving feedback without (n=908) vs with (n=908) highlighted text. For both of these secondary comparisons, the type-I error rate is set at 2.5% 2-sided to control for multiplicity.

Statistical analysis
The main analysis will consist of comparing the rate of diagnostic imaging requests for each GP per 1000 Category 1 services. Data will be aggregated at the GP level and analysed using linear regression adjusted for the baseline imaging rate of each GP as well as the variables used to stratify the randomisation. Clustering of GPs by practice will be accounted for by using a random effect model or generalised estimating equations.

The primary comparison will consist of comparing the four intervention arms to the control arm. The overall effect of the intervention will be estimated as the adjusted mean difference together with its 95% confidence interval. Using the same linear regression model, we will also estimate the effect of the number of feedback occasions (one vs two) and the effect of the highlighted text (no vs yes) using adjusted mean differences and 97.5% confidence intervals. A similar approach will be used to analyse the secondary outcomes.

Additional models with additional baseline covariates will be considered together with subgroup analyses. Details will be pre-specified in a separate statistical analysis plan developed with no access to unblinded trial data.

Trial registration

The trial will be registered in the Australian New Zealand Clinical Trials Registry (ANZCTR) before enrolment of participants.

REFERENCES

1. Hartvigsen J, Hoy D, Smeets R, et al. What low back pain is and why we need to pay attention. Lancet 2018;391:2356-67.
2. Britt H, Miller GC, Henderson J, et al. General practice activity in Australia 2015–16. Sydney2016.
3. Jordan KP, Kadam UT, Hayward R, Porcheret M, Young C, Croft P. Annual consultation prevalence of regional musculoskeletal problems in primary care: an observational study. BMC Musculoskeletal Disorders 2010;11:144.
4. Brownlee S, Chalkidou K, Doust J, et al. Evidence for overuse of medical services around the world. Lancet 2017;390:156-68.
5. Darlow B, Forster BB, O'Sullivan K, O'Sullivan P. It is time to stop causing harm with inappropriate imaging for low back pain. British Journal of Sports Medicine 2017;51:414-5.
6. Webster BS, Bauer AZ, Choi Y, Cifuentes M, Pransky GS. Iatrogenic consequences of early magnetic resonance imaging in acute, work-related, disabling low back pain. Spine 2013;38:1939-46.
7. Webster BS, Choi YS, Bauer AZ, Cifuentes M, Pransky G. The cascade of medical services and associated longitudinal costs due to nonadherent magnetic resonance imaging for low back pain. Spine 2014;39:1433–40.
8. Brand CA, Harrison C, Tropea J, Hinman RS, Britt H, Bennell KL. Management of osteoarthritis in general practice in Australia. Arthritis Care Res 2014;66:551-8.
9. Buchbinder R, Staples MP, Shanahan M, Roos JF. General practitioner management of shoulder pain in comparison with rheumatologist expectation of care and best evidence: an Australian national survey. PLoS ONE 2013;8:e61243.
10. Foster NE, Koes B, Chou R, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet 2018;391:2368-83.
11. Jenkins HJ, Downie AS, Maher CG, Moloney NA, Magnussen JS, Hancock MJ. Imaging for low back pain: is clinical use consistent with guidelines? A systematic review and meta-analysis. The Spine Journal 2018;18:2266-77.

12. Morrisroe K, Nakayama A, Soon J, et al. EVOLVE: The Australian Rheumatology Association's 'top five' list of investigations and interventions doctors and patients should question. Intern Med J 2018;48:135-43.
13. Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: effects on professional practice and healthcare outcomes. Cochrane Database of Systematic Reviews 2012;6:Art. No.: CD000259.
14. Ivers NM, Grimshaw JM, Jamtvedt G, et al. Growing literature, stagnant science? systematic review, meta-regression and cumulative analysis of audit and feedback interventions in health care. J Gen Intern Med 2014;29:1534-41.
15. Brehaut JC, Colquhoun HL, Eva KW, et al. Practice feedback interventions: 15 suggestions for optimizing effectiveness. Ann Intern Med 2016;164:435-41.
16. Colquhoun HL, Brehaut JC, Sales A, et al. A systematic review of the use of theory in randomized controlled trials of audit and feedback. Implement Sci 2013;8:66.
17. Brown B, Gude WT, Blakeman T, et al. Clinical Performance Feedback Intervention Theory (CP-FIT): a new theory for designing, implementing, and evaluating feedback in health care based on a systematic review and meta-synthesis of qualitative research. Implementation Science 2019;14:40.
18. Carver CS, Scheier MF. Control theory: a useful conceptual framework for personality - social, clinical, and health psychology. Psychological Bulletin 1982;92:111-35.
19. Eccles M, Steen N, Grimshaw J, et al. Effect of audit and feedback, and reminder messages on primary-care radiology referrals: a randomised trial. Lancet 2001;357:1406-9.
20. Kerry S, Oakeshott P, Dundas D, Williams J. Influence of postal distribution of the royal college of radiologists guidelines, together with feedback on radiological referral rates, on x-ray referrals from general practice: a randomized controlled trial. Family Practice 2000;17:46-52.
21. Robling MR, Houston HLA, Kinnersley P, et al. General practitioners' use of magnetic resonance imaging: an open randomized trial comparing telephone and written requests and an open randomized controlled trial of different methods of local guideline dissemination. Clinical Radiology 2002;57:402-7.
22. Schectman JM, Schroth WS, Verme D, Voss JD. Randomized controlled trial of education and feedback for implementation of guidelines for acute low back pain. Journal of General Internal Medicine 2003;18:773-80.
23. Winkens RAG, Pop P, Bugter-Maessen AMA, et al. Randomised controlled trial of routine individual feedback to improve rationality and reduce numbers of test requests. Lancet 1995;345:498-502.
24. Ivers NM, Sales A, Colquhoun H, et al. No more 'business as usual' with audit and feedback interventions: towards an agenda for a reinvigorated intervention. Implementation Science 2014;9:14.

Evaluating an audit and feedback intervention for reducing musculoskeletal diagnostic imaging requests by Australian general practitioners: a partial cluster randomised trial

Statistical Analysis Plan

Version: 1.0 (Final)

Date: 6 August 2021

Authors:
Laurent Billot, Brigit Maguire, Dina Schram, Robert Ma, Brett Clark, Rachelle Buchbinder, Christopher Maher, Kirsten McCaffery, Adrian Traeger, Loai Albarqouni, Juliet Checketts, Parima Vyas, Paul Glasziou, Alexandra Gorelik, Denise A O'Connor

(See Page 3 for affiliations)

Study identifiers:
ANZCTR: ACTRN12619001503112

MONASH University
Medicine, Nursing and Health Sciences

The George Institute for Global Health Australia

Cabrini Institute
Education and Research

WISER HEALTHCARE
A RESEARCH COLLABORATION FOR REDUCING OVERDIAGNOSIS AND OVERTREATMENT

Contents

1 ADMINISTRATIVE INFORMATION

1.1 STUDY IDENTIFIERS

- Protocol: version 1.0, 1 May 2021
- Australian New Zealand Clinical Trials Registry, ACTRN12619001503112. Registered 31/10/2019
- Funding details:
  - Australian Government Department of Health
  - Australian National Health and Medical Research Council (NHMRC) Program Grant on 'Using healthcare wisely: reducing inappropriate use of tests and treatments' (APP1113532).
  - Australian NHMRC Translating Research into Practice (TRIP) Fellowship (Denise O'Connor APP1168749).
  - Australian NHMRC Investigator Fellowship (Rachelle Buchbinder APP1194483; Christopher Maher APP1194283; Paul Glasziou APP1155009);
  - Australian NHMRC Early Career Fellowship (Adrian Traeger APP1144026).

1.2 REVISION HISTORY

Version	Date	Changes made to document
0.1 (draft)	16 Jun 2021	Created from the protocol
0.2 (draft)	17 Jun 2021	Minor adjustments following meeting held on 17 June 2021
0.3 (draft)	21 Jul 2021	Final draft incorporating comments from wider team
0.4 (draft)	02 Aug 2021	Redefined the analysis populations
1.0 (draft)	06 Aug 2021	Finalised remaining comments

1.3 CONTRIBUTORS TO THE STATISTICAL ANALYSIS PLAN

1.3.1 ROLES AND RESPONSIBILITIES

Name	Affiliation	Role on study	SAP contribution
Laurent Billot	The George Institute for Global Health, Faculty of Medicine, University of New South Wales, Newtown, NSW, 2042, Australia	Trial statistician	Prepared first draft
Denise O'Connor	Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University, Melbourne, Victoria, 3004, Australia Monash-Cabrini Department of Musculoskeletal Health and Clinical Epidemiology, Cabrini Health, Malvern, Victoria, 3144, Australia	Principal investigator	Reviewed every version
Brigit Maguire	Australian Government Department of Health, PO Box 9848, Canberra, ACT, 2601	Trial statistician	Reviewed every version

Dina Schram	Australian Government Department of Health, PO Box 9848, Canberra, ACT, 2601	Investigator	Reviewed every version
Robert Ma	Australian Government Department of Health, PO Box 9848, Canberra, ACT, 2601	Investigator	Reviewed every version
Rachelle Buchbinder	Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University, Melbourne, Victoria, 3004, Australia Monash-Cabrini Department of Musculoskeletal Health and Clinical Epidemiology, Cabrini Health, Malvern, Victoria, 3144, Australia	Investigator	Reviewed and approved final version
Christopher Maher	Institute for Musculoskeletal Health, Sydney Local Health District and The University of Sydney, Camperdown, NSW, 2006, Australia	Investigator	Reviewed and approved final version
Kirsten McCaffery	Sydney Health Literacy Lab, Sydney School of Public Health, Faculty of Medicine and Health, The University of Sydney, Camperdown, NSW, 2006, Australia	Investigator	Reviewed and approved final version
Adrian Traeger	Institute for Musculoskeletal Health, Sydney Local Health District and The University of Sydney, Camperdown, NSW, 2006, Australia	Investigator	Reviewed and approved final version
Loai Albarqouni	Institute for Evidence-Based Healthcare, Faculty of Health Sciences and Medicine, Bond University, Robina, Queensland, 4226, Australia	Investigator	Reviewed and approved final version
Alexandra Gorelik	Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University, Melbourne, Victoria, 3004, Australia Monash-Cabrini Department of Musculoskeletal Health and Clinical Epidemiology, Cabrini Health, Malvern, Victoria, 3144, Australia	Biostatistician	Reviewed and approved final version

1.3.2 APPROVALS

The undersigned have reviewed this plan and approve it as final. They find it to be consistent with the requirements of the protocol as it applies to their respective areas. They also find it to be compliant with ICH-E9 principles and, in particular, confirm that this analysis plan was developed in a completely blinded manner (i.e. without knowledge of the effect of the intervention(s) being assessed).

Laurent Billot

6 Aug 2021

Denise O'Connor

D. O'Connor

6 Aug 2021

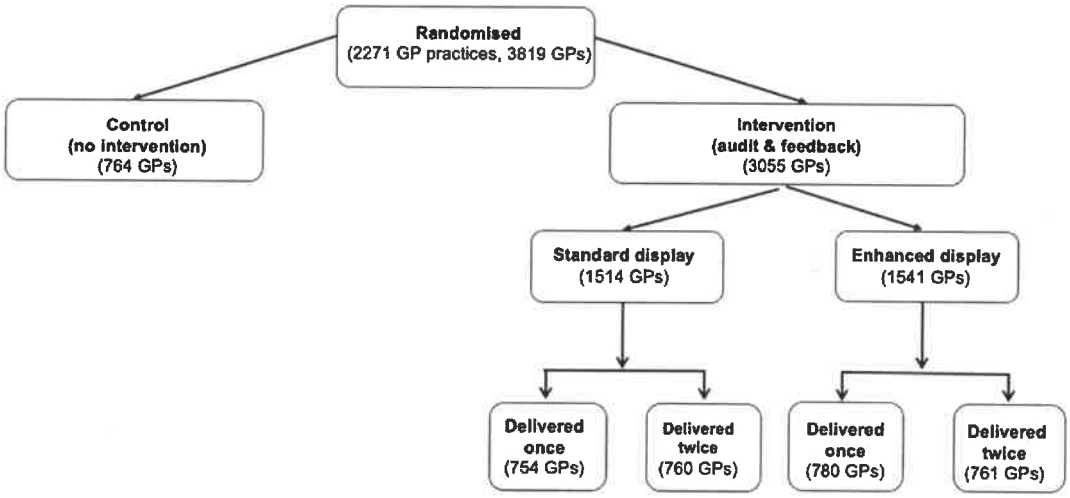
Brigit Maguire

BMaguire 6/8/2021

2 STUDY SYNOPSIS

The primary objective of this trial is to estimate the effectiveness of audit and feedback for reducing diagnostic imaging requests for 11 musculoskeletal imaging services (lumbosacral X-ray and CT, cervical spine X-ray, CT and MRI, shoulder X-ray and ultrasound, hip X-ray and ultrasound, knee X-ray and ankle/hind foot ultrasound) in high requesting GPs in Australia compared with control.

This is a 5-arm partial 2 x 2 factorial cluster randomised trial testing variations in the design and delivery of audit and feedback for reducing musculoskeletal diagnostic imaging requests in Australian general practice. A 2 x 2 factorial design is used to simultaneously assess the effect of two factors: (1) frequency of delivery of feedback and (2) an enhanced feedback display. A no intervention control group is included to test the effectiveness of any form of audit and feedback (Figure).



2.1 STUDY OBJECTIVES

2.1.1 PRIMARY OBJECTIVE

The primary objective of this trial is to assess whether the intervention (audit and feedback) reduces the rates of diagnostic imaging requests for 11 musculoskeletal imaging services.

The primary hypothesis is that the intervention will reduce the mean rate of diagnostic imaging requests for 11 musculoskeletal imaging services over 12 months from randomisation when compared to the control group.

2.1.2 SECONDARY OBJECTIVES

A secondary objective is to evaluate which forms of feedback are most effective in reducing musculoskeletal diagnostic imaging requests and to estimate their effects.

2.2 POPULATION

2.2.1 INCLUSION CRITERIA

We included GPs practising in Australia who were:

- in the top 20% of GP referrers overall for 11 targeted musculoskeletal diagnostic imaging services
- in the top 20% of GP referrers for at least four individual imaging services, within the 12-month period of 1 January 2018 to 31 December 2018.

The 11 targeted imaging services were: lumbosacral X-ray and CT, cervical spine X-ray, CT and MRI, shoulder X-ray and ultrasound, hip X-ray and ultrasound, knee X-ray and ankle/hind foot ultrasound.

2.2.2 EXCLUSION CRITERIA

We excluded GPs who:

- did not make any musculoskeletal diagnostic imaging requests for the 11 targeted services within the 12-month period of 1 January 2018 to 31 December 2018
- had less than 1000 Category 1 (professional attendance) services over that same time period
- participated in qualitative interviews with members of the research team to user test the interventions
- were involved in an Australian Government Department of Health compliance activity during the period of 1 January 2018 to 25 October 2019.

2.3 OUTCOMES

2.3.1 PRIMARY OUTCOME

The primary outcome is the overall rate of diagnostic imaging requests for the 11 targeted musculoskeletal imaging services that are rendered by a radiologist over the 12 months following randomisation for each GP per 1000 Category 1 services using Medicare Benefits Schedule (MBS) data. The 11 targeted imaging services are: lumbosacral X-ray and CT, cervical spine X-ray, CT and MRI, shoulder X-ray and ultrasound, hip X-ray and ultrasound, knee X-ray and ankle/hind foot ultrasound.

2.3.2 SECONDARY OUTCOMES

The rate of requests for each GP per 1000 Category 1 services for the targeted 11 musculoskeletal imaging services will be assessed at 6 months and 18 months after randomisation in addition to 12 months (primary timepoint).

In addition, each of the 11 individual services will be analysed at 6, 12 and 18 months:

- Lumbosacral CT requests
- Lumbosacral x-ray requests
- Cervical spine CT requests
- Cervical spine x-ray requests
- Cervical spine MRI requests
- Shoulder x-ray requests
- Shoulder ultrasound requests
- Hip x-ray requests
- Hip ultrasound requests
- Knee x-ray requests
- Ankle/hind foot ultrasound requests

Ankle x-ray requests will also be analysed at 6, 12 and 18 months because ankle x-ray is considered a possible substitute for ankle/hind foot ultrasound.

All outcomes will be estimated as the rate of requests per 1000 category 1 services using MBS as the data source.

2.4 INTERVENTION

Control group

GPs allocated to the control group (Group 1) will not receive any audit and feedback information on their musculoskeletal diagnostic imaging requesting during the trial.

Interventions

GPs allocated to one of four intervention groups (Groups 2-5) will receive written audit and feedback from the Chief Medical Officer of Australia on their diagnostic imaging request rate for the 11 targeted imaging services compared with the request rate of their Australian GP peers. The audit and feedback interventions were designed by the research team in consultation with the Australian Government Department of Health and refined in user testing with GPs prior to use in the trial. A detailed description of each intervention being assessed is contained in the protocol.

The factorial design allowed us to evaluate two factors in the audit and feedback intervention that are potential effect modifiers: the frequency of feedback and inclusion of an enhanced display.

Factor 1: Frequency of feedback

GPs received feedback on their diagnostic imaging request rate for the 11 musculoskeletal imaging services either on one occasion (at baseline on 8th November 2019) or on two occasions (at baseline on 8th November 2019 and at 12 months on 9th November 2020). One of the four intervention groups (Group 2) received audit and feedback delivered on one occasion (at baseline on 8th November 2019). It presented the GP's overall diagnostic imaging request rate per 1000 consultations for the 11 musculoskeletal diagnostic imaging services compared with their Australian GP peers in the same geographic stratum (i.e., metropolitan or regional/rural/remote) over the previous calendar year (1 January 2018 to 31 December 2018) in graphical format. The report also presented the GP's number of requests and request rate per 1000 consultations for each of the 11 musculoskeletal diagnostic imaging services compared with their peers in the same geographic stratum over the same time period in tabular format.

Another of the four intervention groups (Group 4) received audit and feedback as described in Group 2 with the exception of an additional statement advising recipients that they would receive updated feedback on their diagnostic imaging requesting in 9-12 months' time. This group then received audit and feedback on a second occasion (at 12 months on 9th November 2020). The second report presented the GP's overall diagnostic imaging request rate per 1000 consultations in graphical format for the 11 musculoskeletal diagnostic imaging services compared with their GP peers in the same geographic stratum over the four-month period following the first feedback report (8 November 2019 to 7 March 2020). It also presented their request rate per 1000 consultations for each of the 11 musculoskeletal diagnostic imaging services compared with their peers in the same geographic stratum in tabular format over two time periods: (i) the first time period of 1 January 2018 to 31 December 2018 and (ii) the second time period of 8 November 2019 to 7 March 2020.

Factor 2: Inclusion of enhanced display

GPs received feedback on their diagnostic imaging request rate for the 11 musculoskeletal imaging services using either standard or enhanced feedback display. The enhanced feedback display used yellow shading in the table on page 3 of the feedback report to draw recipients' attention to the specific musculoskeletal diagnostic imaging services where their request rate was in the top 20% of referrers and where behaviour change may be required. One of the four intervention groups (Group 3) received audit and feedback with enhanced feedback display on one occasion (at baseline on 8th November 2019). Another of the four intervention groups (Group 5) received audit and feedback with enhanced feedback display on two occasions (at baseline on 8th November 2019 and at 12 months on 9th November 2020).

2.5 RANDOMISATION AND BLINDING

General practices, with at least one eligible GP, were simultaneously randomised either to no intervention control or to one of four intervention groups at baseline on 8th November 2019. GPs were clustered based on matched primary practice addresses. The randomisation sequence was generated using a computer-generated randomisation algorithm in the statistical program R. Randomisation of general practices was stratified by geographic region.

Trial participants (i.e., GPs) are not blinded to group allocation but the risk of performance bias is considered to be minimal as GPs were not aware of the variations of audit and feedback being tested nor the outcome measures and analytical approach.

2.6 SAMPLE SIZE

The primary endpoint is the rate of diagnostic imaging requests (for the 11 musculoskeletal services) for each GP per 1000 Category 1 services measured over 12 months from randomisation. A total of 2,271 general practices were identified as eligible for inclusion in the study. Using a 4-to-1 randomisation ratio, this sample size provides >90% power to detect a mean difference of 1.1 requests per 1000 services in the average rate of diagnostic imaging requests in GPs receiving any intervention compared with control. This calculation assumes a standard deviation of 7 as observed in a previous data extract and a two-sided type-I error rate of 5%. It conservatively assumes that each cluster will be of size one (i.e., a single GP per practice); however, we expect a number of practices to include two or more GPs.

This sample size also provides >90% power to detect a difference of 1.1 requests in the mean rate of diagnostic imaging requests between general practices receiving feedback on one occasion vs. two occasions and between those receiving feedback with vs. without enhanced feedback display. For both of these secondary comparisons, the type-I error rate is set at 2.5% 2-sided to control for multiplicity.

3 STATISTICAL ANALYSIS

3.1 GENERAL PRINCIPLES

This statistical analysis plan has been developed by the trial statistician blinded to group allocation. Analyses will be independently conducted by two statisticians using randomly shuffled group allocations. Real allocations will only be revealed once analyses are completed and agreement between the two statisticians is reached.

All analyses will be performed using either R (version 4.1.0) or Stata (version 15 or more).

3.2 INTERIM ANALYSES

Not applicable

3.3 MULTIPLICITY ADJUSTMENT

The primary comparison (intervention vs control) will be conducted using a 2-sided type-I error rate of 5% across all outcomes. Comparisons of the number of feedback occasions (one vs two occasions) and type of feedback (with vs without enhanced display) will be performed using a 2-sided type-I error rate of 2.5% across all outcomes. We will not formally adjust for multiplicity across secondary outcomes; however, secondary outcome results will be interpreted while taking into account the multiple tests conducted and will mostly be used to assist in the interpretation of the primary outcome results i.e. to assess the consistency of results across outcomes and identify potential contributors.

3.4 BLIND REVIEW

Not applicable

3.5 DATA SETS TO BE ANALYSED

Three analysis populations will be defined:

1) The ***intention-to-treat*** (ITT) population will include all randomised GPs who will be analysed according to the group they were randomised to, regardless of the number of patient consultations (i.e., Category 1 professional attendance services) provided or whether they received the allocated intervention as planned.
2) The ***practising*** population will exclude GPs who had no Category 1 professional attendance services during the 18-month period of 8 November 2019 to 8 May 2021 indicating they had no opportunity to modify their musculoskeletal diagnostic imaging requesting. The practising population will be analysed according to the group they were randomised to.
3) The ***active*** population will exclude GPs who had fewer than 1500 Category 1 professional attendance services for the 18-month period of 8 November 2019 to 8 May 2021 indicating they had limited opportunity to modify their musculoskeletal diagnostic imaging requesting. The active population will be analysed according to the group they were randomised to.
4) The ***per-protocol*** population will consist of GPs who received the allocated intervention as planned. It will exclude GPs that (i) had their audit and feedback reports returned undelivered, (ii) were allocated to receive audit and feedback on a second occasion but requested not to receive a second report (and were not mailed the second report)), (iii) were allocated to receive audit and feedback on a second occasion but did not make any musculoskeletal diagnostic imaging requests during the audit period of 8 November 2019 to 7 March 2020; and (iv) were allocated to receive audit and feedback on a second occasion but had fewer than 333.3 Category 1 professional attendance services during the four-month audit period of 8 November 2019 to 7 March 2020 so calculating their requesting percentile was not reliable and subsequently not reported on the second occasion.

All analyses will be conducted in the ITT population. To assess the robustness of the results after excluding GPs with zero

or low levels of activity, we will repeat the main analyses in the practicing, active and per-protocol populations respectively.

3.6 SUBJECT DISPOSITION

The status of subjects will be described using a CONSORT flowchart.

3.7 SUBJECT CHARACTERISTICS AND BASELINE COMPARISONS

All baseline characteristics will be summarised using numbers and percentages for categorical variables and mean, standard errors, minimum, maximum, median and quartiles for continuous variables. The following baseline variables will be described:

- Socio-demographic characteristics:
  - Age (categorised in age bands)
  - Gender
  - Geographical region (metropolitan vs others)
  - State or territory of Australia
- Services provided during the baseline period (1 January 2018 to 31 December 2018):
  - Overall requesting percentile for the 11 targeted musculoskeletal diagnostic imaging services
  - Number of targeted musculoskeletal diagnostic imaging services $\geq 80^{th}$ percentile
  - Lumbosacral x-ray requesting rate per 1000 Category 1 services
  - Shoulder x-ray requesting rate per 1000 Category 1 services
  - Cervical spine x-ray requesting rate per 1000 Category 1 services
  - Knee x-ray requesting rate per 1000 Category 1 services
  - Hip x-ray requesting rate per 1000 Category 1 services
  - Lumbosacral CT requesting rate per 1000 Category 1 services
  - Cervical spine CT requesting rate per 1000 Category 1 services
  - Cervical spine MRI requesting rate per 1000 Category 1 services
  - Shoulder ultrasound requesting rate per 1000 Category 1 services
  - Ankle/hind foot ultrasound requesting rate per 1000 Category 1 services
  - Hip ultrasound requesting rate per 1000 Category 1 services
  - Overall requesting rate for the 11 targeted musculoskeletal diagnostic imaging services per 1000 Category 1 services
  - Total number of requests for the 11 targeted musculoskeletal diagnostic imaging services
  - Total number of Category 1 services

3.8 COMPLIANCE TO STUDY INTERVENTION(S)

Not applicable

3.9 CONCOMITANT THERAPIES

Not applicable

3.10 PERCENTAGE RANKS

We will describe shifts in percentage ranks over time using Sankey diagrams. This will be done using four timepoints (baseline, month 6, month 12 and month 18) and by categorising ranks in 3 categories (under 80^{th} percentile, 80^{th} to $<90^{th}$

percentile, 90th and above). This will be done for the primary outcome only both for the main comparison (intervention vs control) and according to the four intervention groups.

3.11 ANALYSIS OF THE PRIMARY OUTCOME

The primary outcome is the overall rate of diagnostic imaging requests for the 11 targeted musculoskeletal imaging services that are rendered by a radiologist over the 12 months following randomisation for each GP per 1000 Category 1 services using MBS data. Data will be aggregated at the GP level and analysed using linear regression. The dependent variable for the linear regression will therefore be the individual imaging rate of each GP.

3.11.1 MAIN ANALYSIS

The distribution of raw imaging rates at months 6, 12 and 18 will be described using longitudinal mean plots by intervention arm; first comparing the combined intervention group to the control group, second by comparing all 4 intervention groups.

The main analysis will consist of comparing the mean rate of diagnostic imaging requests between the control and intervention group. The regression model will be adjusted for the baseline imaging rate of each GP as well as remoteness. To remove skewness and potential heteroscedasticity, we will apply a natural log-transformation to the rate (dependent variable) as well as to the baseline rate included as a covariate. Resulting estimates and confidence intervals will be back transformed to the original scale. Clustering of GPs by practice will be accounted for by including a random intercept by practice. For this main analysis, all four intervention groups will be combined and analysed as one group. The effect of the intervention will be estimated as the mean difference in the rate of diagnostic imaging request between the intervention group and the control group together with its 95% confidence interval.

Using the same linear regression model, we will also estimate the effect of the number of audit and feedback occasions (one vs. two) and the effect of the enhanced feedback display (no vs. yes) using adjusted mean differences and 97.5% confidence intervals. We will test for an interaction between the two types of interventions.

3.11.2 ADJUSTED ANALYSES

As a sensitivity analysis, we will repeat the main model described above after adding baseline volume of imaging services, years in general practice, GP age and GP gender as additional covariates to the main model.

3.11.3 SUBGROUP ANALYSES

We will conduct a limited number of subgroup analyses to identify potential differences in intervention effects. The following pre-specified subgroups will be assessed:

1) Baseline service request level: GPs with an overall requesting percentile of 90-99 (highest) versus 80-<90 (high) for the targeted imaging services over the baseline period.
2) Baseline volume of imaging services: GPs with 7-11 (more) versus 4-6 (less) individual imaging services where their requesting percentile is ≥80.
3) Geographical location of primary GP practice: metropolitan versus regional/rural/remote.
4) Years in general practice: in 5-year brackets i.e. 0-<5, 5-<10, 10-<15, 15 or more
5) Gender: male vs female

Subgroup analyses will be conducted by adding the subgroup variable of interest as well as its interaction with the randomised arm to the main analysis model (see Section 3.11.1). For baseline service request level, baseline volume of imaging services and years in general practice, we will also consider the subgroup variable as a continuous variable and test its interaction with the intervention.

3.11.4 TREATMENT OF MISSING DATA

We expect the MBS data to capture all services rendered during the study period and will therefore assume no missing data.

3.11.5 OTHER SENSITIVITY ANALYSES

To account for the potential effect of including GPs who are inactive or with very low levels of service requests, we will repeat the main analysis outlined in Section 3.11.1 in the practising, active and per-protocol populations as defined in Section 3.5.

3.12 ANALYSIS OF SECONDARY OUTCOMES

All secondary outcomes will be analysed using the same approach as the one used for the analysis of the primary outcome i.e. applying natural log-transformations and using a mixed linear model adjusted for the baseline value of the outcome being modelled. Secondary outcomes will only be analysed using the ITT population using the main analysis method described in Section 3.11.1. No further covariate adjustment or subgroup analysis is planned for the secondary outcomes.

3.13 ANALYSIS OF SAFETY OUTCOMES

Not applicable

3.14 ANALYSIS OF <OTHER/TERTIARY/EXPLORATORY> OUTCOMES

Not applicable.

4 REFERENCES

1. O'Connor DA, Buchbinder R, Maher C, McCaffery K, Traeger A, Albarqouni L, Checketts J, Vyas P, Billot L, Schram D, Maguire B, Ma R, Clark B, Glasziou P. Evaluating an audit and feedback intervention for reducing musculoskeletal diagnostic imaging requests by Australian general practitioners: protocol for a partial factorial cluster randomised trial. BMJ Open (submitted 30 June 2021)

5 PROPOSED TABLES AND FIGURES

Figure 1: Consort flowchart

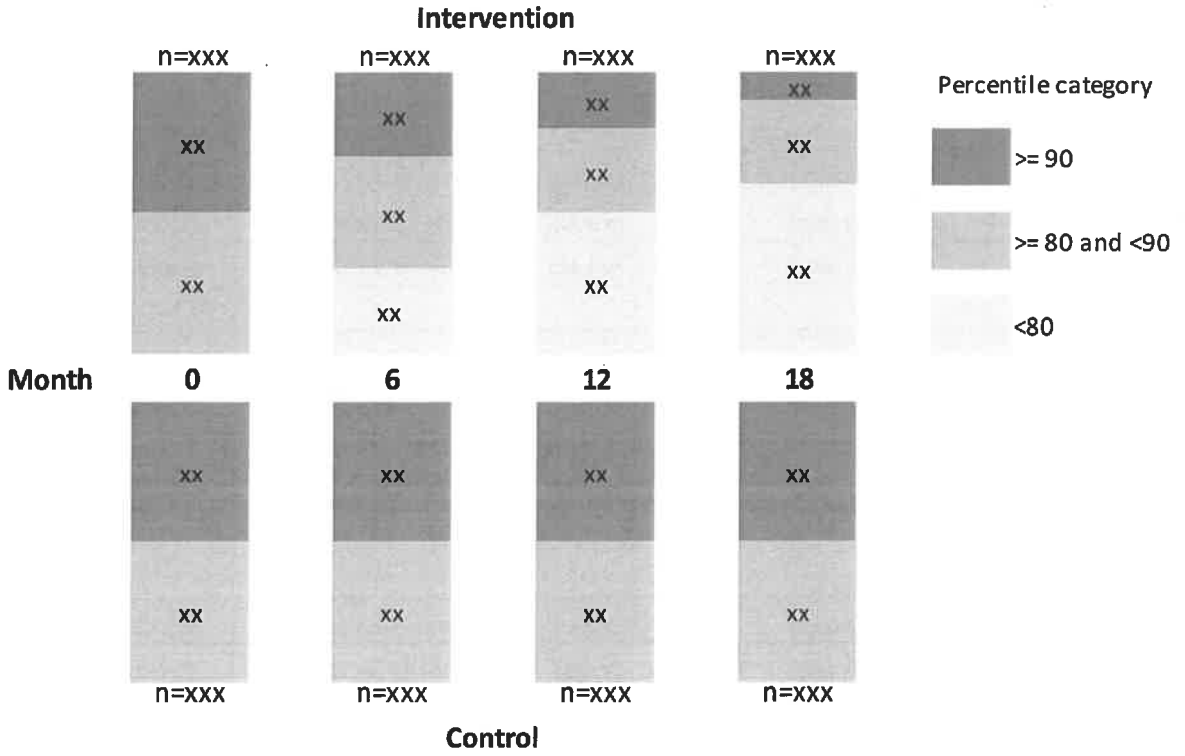
Table 1: Baseline characteristics of GPs (intervention vs control)

	Intervention (N=xxx)	Control (N=xxx)	Total (N=xxx)
GP age (years)			
Age band 1	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Age band 2	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Etc.			
Gender			
Female	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Male	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Geographical region			
Metropolitan	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Regional/rural/remote	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
State/territory			
ACT	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
NSW	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
QLD	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
NT	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
SA	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
TAS	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
VIC	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
WA	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Total number of requests for the 11 targeted imaging services			
Mean (SD)	xxx (xxx)	xxx (xxx)	xxx (xxx)
Median (Q1 – Q3)	xxx (xxx – xxx)	xxx (xxx – xxx)	xxx (xxx – xxx)
Min - Max	xxx - xxx	xxx - xxx	xxx - xxx
Etc. for all service categories			

Table 1b: Baseline characteristics of GPs (four intervention groups)

	One feedback occasion + Standard display (N=xxx)	One feedback occasion + enhanced display (N=xxx)	Two feedback occasions + Standard display (N=xxx)	Two feedback occasions + enhanced display (N=xxx)
GP age (years)				
Age band 1	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Age band 2	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Etc.				
Gender				
Female	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Male	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Geographical region				
Metropolitan	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Regional/rural/remote	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
State/territory				
ACT	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
NSW	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
QLD	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
NT	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
SA	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
TAS	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
VIC	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
WA	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)	xxx (xx.x%)
Total number of requests for the 11 targeted imaging services				
Mean (SD)	xxx (xxx)	xxx (xxx)	xxx (xxx)	xxx (xxx)
Median (Q1 – Q3)	xxx (xxx – xxx)	xxx (xxx – xxx)	xxx (xxx – xxx)	xxx (xxx – xxx)
Min - Max	xxx - xxx	xxx - xxx	xxx - xxx	xxx - xxx
Etc. for all service categories				

Figure 2: Sankey diagram of percentage rank of total in-scope requests per 1,000 Category 1 services



Programming notes:

- *Add lines that connect the bars and show the flow of GPs shifting between categories from one timepoint to the next*
- *Create a four-panel version showing the same thing for the four intervention groups*

Figure 3: Raw imaging request rates over time (main comparison): primary outcome

Programming notes:

- *Display mean rate and 95% confidence interval per group (intervention vs control) at each month from baseline (month 0) until month 18.*
- *Do the same figure for all secondary outcomes. Also create similar figures for 4 intervention groups (not showing control).*

Table 2: Analysis of primary and secondary outcomes for the main comparison

	Intervention Mean rate (SE)	Control Mean rate (SE)	Adjusted mean difference (95% CI)	P-value
Overall request rate for 11 imaging services				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months *	**x.xx (x.xxx)**	**x.xx (x.xxx)**	**x.xx (x.xx to x.xx)**	**0.xxx**
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Lumbosacral CT				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Lumbosacral x-ray				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Cervical spine CT				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Cervical spine x-ray				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Cervical spine MRI				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Shoulder x-ray				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Shoulder ultrasound				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx

Hip x-ray				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Hip ultrasound				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Knee x-ray				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Ankle/hind foot ultrasound				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Ankle x-ray				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx

* primary outcome

Table 2b: Analysis of primary and secondary outcomes according to frequency of feedback

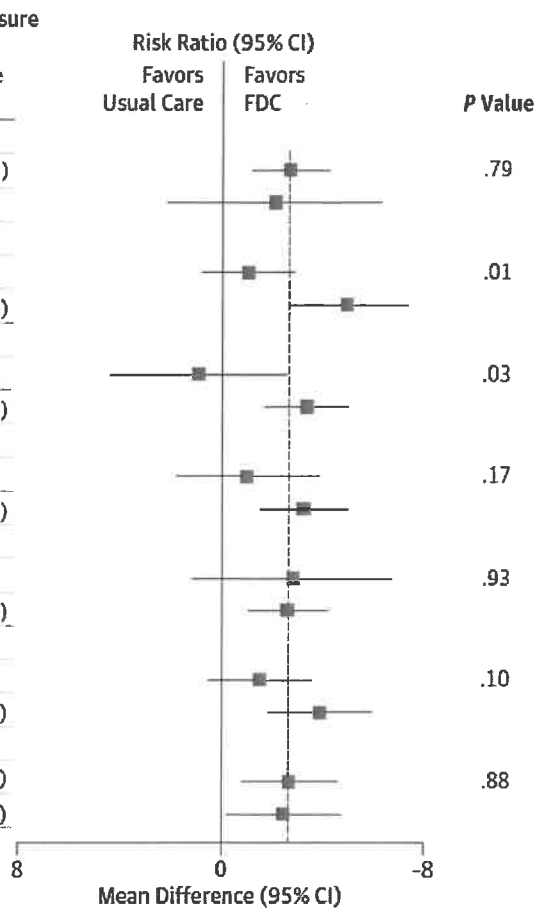
	Two occasions Mean rate (SE)	One occasion Mean rate (SE)	Adjusted mean difference (97.5% CI)	P-value
Overall request rate for 11 imaging services				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Lumbosacral CT				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Etc. for all secondary outcomes				

Table 2c: Analysis of primary and secondary outcomes according to display

	Enhanced display Mean rate (SE)	Standard display Mean rate (SE)	Adjusted mean difference (97.5% CI)	P-value
Overall request rate for 11 imaging services				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Lumbosacral CT				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Etc. for all secondary outcomes				

Figure 4: Forest plot for subgroup analysis of primary outcome

	SBP, Mean (SE), mm Hg		Mean Difference (95% CI)
	Usual Care	FDC	
CVD risk			
Established CVD	131.3 (0.6)	128.6 (0.6)	-2.7 (-4.2 to -1.1)
≥15% 5-y CVD risk	135.4 (1.5)	133.3 (1.5)	-2.0 (-6.3 to 2.2)
Adherence to indicated medication at baseline			
Yes	131.7 (0.7)	130.7 (0.7)	-1.0 (-2.9 to 0.8)
No	131.8 (0.9)	126.8 (0.8)	-4.9 (-7.3 to -2.6)
Sex			
Female	129.9 (1.3)	130.9 (1.2)	1.0 (-2.5 to 4.4)
Male	132.1 (0.6)	128.8 (0.6)	-3.3 (-4.9 to -1.7)
Diabetes			
Yes	132.3 (1.0)	131.4 (1.0)	-1.0 (-3.7 to 1.8)
No	131.5 (0.6)	128.3 (0.6)	-3.2 (-4.9 to -1.5)
Smoking			
Yes	130.5 (1.4)	127.7 (1.5)	-2.8 (-6.7 to 1.2)
No	131.9 (0.6)	129.4 (0.6)	-2.6 (-4.1 to -1.0)
Continent			
Europe	133.9 (0.7)	132.4 (0.7)	-1.5 (-3.4 to 0.5)
India	129.5 (0.7)	125.7 (0.7)	-3.8 (-5.9 to -1.8)
FDC choice			
Version 1	130.8 (0.7)	128.1 (0.7)	-2.7 (-4.5 to -0.8)
Version 2	133.1 (0.8)	130.6 (0.8)	-2.4 (-4.7 to -0.2)



Programming note: use the above plot (source: https://doi.org/10.1001/jama.2013.277064) as an example

Table 3: Sensitivity analyses of the primary outcome for the main comparison

	Intervention Mean rate (SE)	Control Mean rate (SE)	Adjusted mean difference (95% CI)	P-value
ITT population				
Main model [1]				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
*12 months **	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Adjusted model				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Practising population				
Main model [1]				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
*12 months **	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Adjusted model				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Active population				
Main model [1]				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
*12 months **	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Adjusted model				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Per-protocol population				
Main model [1]				
6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
*12 months **	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
Adjusted model				

6 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
12 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx
18 months	x.xx (x.xxx)	x.xx (x.xxx)	x.xx (x.xx to x.xx)	0.xxx

* primary timepoint