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Back pain Assessment Clinic (BAC) based in Primary Care – a safe, effective and cost-saving model. Results of a 12-month pilot project.

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Competing Interest Declaration

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare that the submitted work was supported by a workforce innovation grant [ADD/14/7009] provided by the Victorian Department of Health and Human Services. JHYM has received support for conference travel from Abbvie and Pfzier, and honoraria from Abbvie, Janssen and Pfizer. JEC has received consultancy fees from Emerging Implant Technologies GmbH and Medtronic Australasia.

Details of Contributors

Contributors: Study design: JHYM, UP, ADG, DL, TIY, JEC, IPW; data acquisition: JHYM, UP, ADG; data analysis and interpretation: JHYM, UP, ADG, DL, TIY, JEC, IPW; statistical analysis: DL. JHYM takes responsibility that this study has been reported honestly, accurately and transparently and is the study guarantor. All authors (JHYM, UP, ADG, DL, TIY, JEC, IPW) contributed important intellectual content during manuscript drafting and revision, accept accountability for the work and have approved the final version for publication.

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ABSTRACT

Objectives. To evaluate the implementation of the **B**ack pain **A**ssessment **C**linic (**BAC**) model.

Design. BAC is a new, community-based specialist service for assessing and managing low back pain (LBP). The BAC pilot was supported by a Victorian Department of Health and Human Services grant and was evaluated using the Victorian Innovation Reform Impact Assessment Framework (VIRIAF). Data were obtained by auditing BAC activity (22 July 2014 to 30 June 2015) and conducting surveys and interviews of patients, stakeholders and referrers.

Setting. Tertiary and primary care.

Participants. Adult patients with neck and LBP referred for outpatient surgical consultation.

Main Outcome Measures. VIRIAF outcomes: i) access to care; ii) appropriate and safe care; iii) workforce optimisation and integration; and iv) efficiency and sustainability.

Results. A total of 522 patients were seen during the pilot. Most were referred to hospital services by general practitioners (87%) for LBP (63%) and neck pain (24%). All patients were seen within 10 weeks of referral and commenced community-based allied health intervention within 2-4 weeks of assessment in BAC. Of patients seen, 34% had medications adjusted, 57% were referred for physiotherapy, 3.2% to pain services, 1.1% to rheumatology and 1.8% for surgical review. Less MRI scans were ordered in BAC (6.4%) compared to traditional spinal surgical clinics (89.8%), which translated to a cost-saving of $52,560 over 12-months. Patient and staff satisfaction was high. There have been no patient complaints or adverse incidents.

Conclusion. Evaluation of the BAC pilot indicates it is a safe, effective and potentially cost-saving alternative model of care. Evaluation is ongoing to determine the cost-effectiveness, longer-term and broader societal impact of replicating BAC in other settings.

Study Strengths

- One of the first studies to evaluate the outcomes for patients managed in a primary care based specialist service for assessing and managing back pain referrals to public hospitals, including patient reported functional outcomes, and patient, clinician, and referrer satisfaction
- Longer duration of patient cohort follow up compared with other studies of alternative care models for back pain
- More substantial cost-effective analysis than provided by other studies of alternative models of care for back pain

Study Limitations

- Our study findings are subject to the limitations of an observational study design.

- Interpretation of the evaluation is restricted by the modest sample size of patient and GP responses, limited economic analysis and absence of long-term follow-up.

INTRODUCTION

Low back pain (LBP) is the most prevalent and disabling musculoskeletal condition in the community (1) and places great demands on primary care (2) and hospital services (3, 4). Although most guidelines recommend that LBP should be managed in primary care, many patients are still referred for outpatient surgical review (5-7). In an audit of Royal Melbourne Hospital's (RMH) neurosurgery outpatient waiting list performed in 2013, 68.5% of all 'non-urgent' referrals (971 of 1,418) were made for LBP and the mean waiting time for an initial consultation was 18 months (7). Alternative models of care are therefore needed that provide patients with more timely access to expert assessment and evidence-based management. We report the design, implementation and initial evaluation of a novel care model, called the '**B**ack pain **A**ssessment **C**linic' (**BAC**), which was established as an alternative pathway for outpatient specialist review of neck pain and LBP.

METHODS

Back pain Assessment Clinic (BAC) Model and Pilot

The BAC model and care pathways were developed as a collaborative initiative between Rheumatology, Neurosurgery, Orthopaedics, Chronic Pain and Physiotherapy services at RMH to provide patients within RMH's primary catchment area with rapid access to community-based specialist care for neck and LBP. Weekly clinics were established at a community health centre (Merri Health, MH) and RMH's Royal Park (subacute) campus (RPC). BAC was staffed by advanced practice physiotherapists (APP) and a rheumatology registrar who worked under the guidance of a rheumatologist. The APPs were senior physiotherapists who had postgraduate qualifications, credentialing in advanced practice (8) and extensive experience in spinal surgery clinics.

A 'centralised triage process' was developed to support BAC's implementation. This involved a Rheumatologist (JM), Neurosurgeon (TY), Orthopaedic Spinal Surgeon (JC) and APP (UP) meeting fortnightly to triage new referrals for spinal pain either to BAC or the appropriate outpatient specialist clinic. Consensus criteria were established regarding the conditions which were suitable for BAC (Table 1). In general, referrals were excluded from BAC if surgery was considered highly likely or 'red flag' causes of LBP were present; the latter were escalated for rapid specialist consultation.

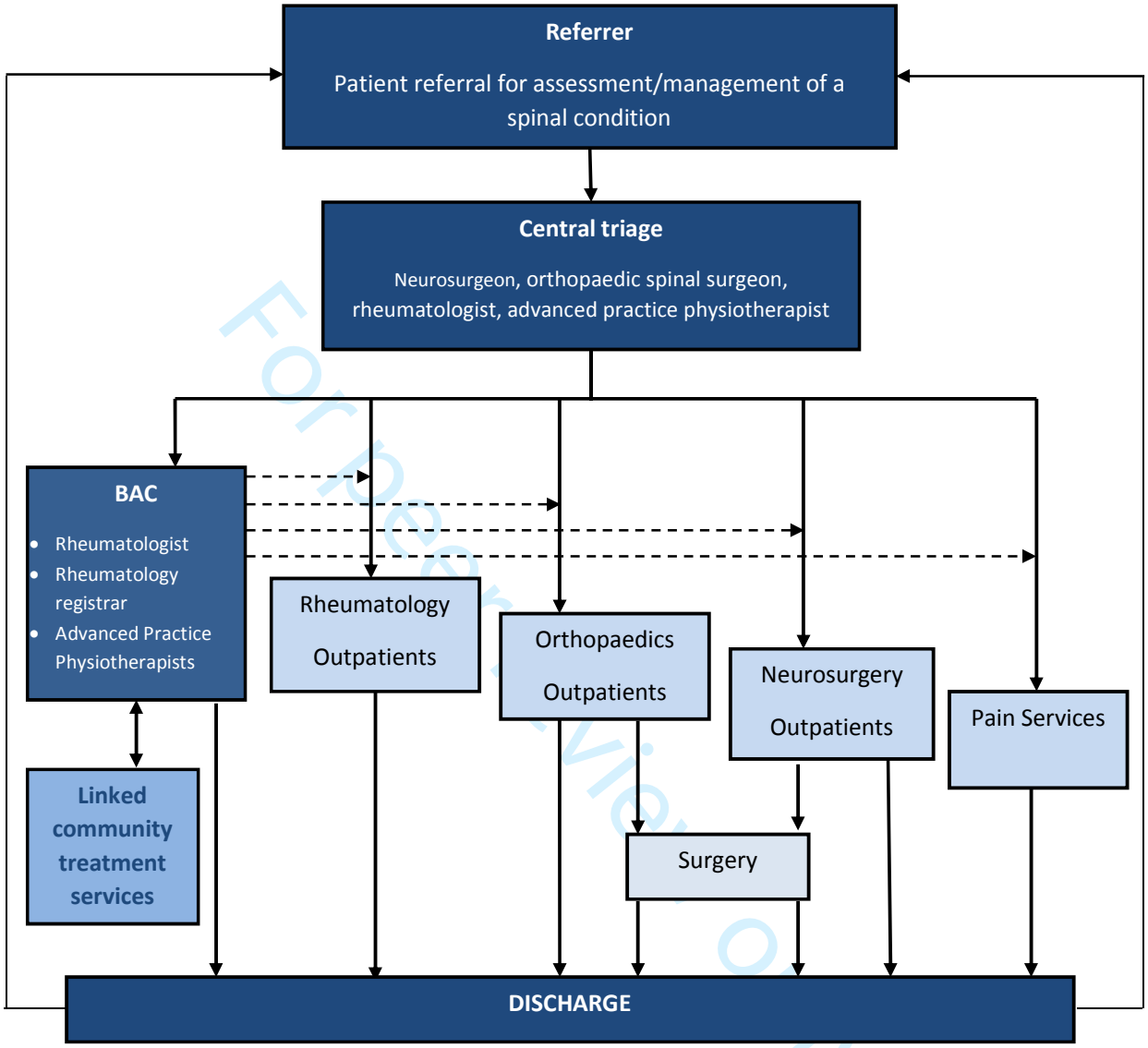
Patients were assessed in BAC within 10 weeks of referral. Prior to BAC consultation, patients received a questionnaire that collected information on demographics, medical history, Brief Pain Inventory (BPI) short form (9), and Oswestry Disability Index (ODI) (10) or Neck Disability Index (NDI) scores (11). In BAC, patients were clinically assessed and screened for 'red flags', questionnaire responses were reviewed and an evidence-based management plan was developed. Patients requiring active exercise intervention were referred and seen within 2-4 weeks in newly developed community-based spinal rehabilitation programs (MH, Cohealth). Patients requiring Neurosurgery, Orthopaedic Spinal Surgery, Rheumatology or Chronic Pain services were seen within 12 weeks with appropriate investigations arranged (Figure 1). After completing the 12-week community-based spinal rehabilitation program, patients were reassessed using the ODI/NDI, BPI (-I: interference, -S: severity) and Global Improvement Scale (GIS) (12).

The BAC pilot ran from 22 July 2014 to 30 June 2015, funded by a Workforce Innovation Grant from the Victorian Department of Health and Human Services (DHHS). Appropriate patients within RMH's primary catchment area already on the outpatient surgical waiting lists were also offered a BAC appointment. The assessment (BAC) and management clinics (MH) became collectively known as the '**B**ack pain **A**ssessment and **M**anagement **S**ervice' (**BAMS**).

Table 1. Consensus inclusion and exclusion criteria for BAC.

Inclusion Criteria
• New and existing referrals on outpatient spinal surgical waiting lists. • Referrals triaged 'non-urgent' or assigned a 'next available' appointment by neurosurgery and orthopaedic spinal units. • Spinal pain with or without referred limb symptoms. • Absence of 'red flags'. • Low likelihood of surgical intervention. • Age greater than 16 years.
Exclusion Criteria
• Radiological or clinical features confirming or raising the suspicion of 'red flags' e.g. spinal infection, malignancy, fracture, spinal inflammation, spinal cord compression (e.g. cervical myelopathy) or cauda equina syndrome. • Spinal trauma, instability (e.g. atlantoaxial instability), recent spinal fracture or spinal surgery within the last 2 years. • Brain or spinal cord injury or malformation. • Radiological evidence of moderate-to-severe central canal stenosis, lateral recess or foraminal stenosis, or a large disc protrusion accompanied by signs and symptoms of radiculopathy or neurogenic claudication. • Worsening upper or lower motor neuron deficits. • Radiculopathy accompanied by limb weakness e.g. foot drop. • Moderate-to-severe scoliosis with Cobb angle >20 degrees. • Peripheral entrapment neuropathies e.g. carpal tunnel syndrome. • High likelihood of need for surgical intervention. • Failed adequate trial of non-operative management for a potentially surgically amenable condition (e.g. spondylolisthesis with persistent symptoms). • Presence of a comorbid condition that also requires surgical assessment and management. • Referral from another consultant surgeon or physician to neurosurgery or orthopaedic spinal surgery. • Patients already well-known to neurosurgery, orthopaedics, rheumatology or chronic pain services. • Referrals for consideration of spinal surgical device implantation (e.g. spinal cord stimulators). • Patient and/or GP preference for patients to be assessed by a surgeon. • Patients referred for medicolegal opinions or compensable claims e.g. Transport Accident Commission (TAC), WorkSafe Victoria.

Figure 1. Health service redesign for managing back and neck pain referrals implemented during the BAC pilot.



Evaluation Framework and Data Collection

BAC was evaluated using the Victorian Innovation Reform Impact Assessment Framework (VIRIAF) (13), in line with Victorian DHHS requirements. Key areas of evaluation were: i) access to care; ii) appropriate and safe care; iii) workforce optimisation and integration; and iv) efficiency and sustainability.

Quantitative data were obtained from auditing the centralised triage process and BAC activity from 22 July 2014 to 30 June 2015. Qualitative data were collected from surveys and interviews of patients (n=54), stakeholders (includes Neurosurgeons, Orthopaedic surgeons, Rheumatologists, hospital and community health managers and Physiotherapists) (n=14) and referrers (n=26) between 1 March 2015 and 30 June 2015. The BAC pilot evaluation was approved by the Melbourne Health Human Research Ethics Committee (QA2014148).

Statistical Methods

Descriptive data were summarised using mean (SD) or median (IQR) for continuous variables and n (%) for categorical variables. Data on referral sources and waiting times were analysed for the whole cohort, while health services utilisation was analysed according to two subgroups: i) patients referred to and reviewed in BAC; and ii) patients referred to but not reviewed in BAC. Magnetic resonance imaging (MRI) costs were calculated using the Medicare Benefits Schedule (MBS) fee of $358.40 for spinal MRI (item numbers 63161, 63164, 63167, 63170, 63173, 63176, 63179, 63182, 63185), and the MRI utilisation rates in outpatient neurosurgery clinics for assessing spinal conditions was assumed to be 89.8% in line with published data (14). A p value <0.05 was considered statistically significant. All analyses were performed using SPSS, version 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows. Armonk, NY, USA).

RESULTS

Study Population

Patient demographics are summarised in Table 2. The majority (73.7%) of new referrals to RMH surgical clinics were deemed appropriate for BAC by the centralised triage team. In total, 522 in-catchment patients were referred to BAC (83.3% re-directed from neurosurgery, 13.2% from orthopaedics), of whom 51.5% (n=272) were new referrals and 48.5% (n=250) were drawn from specialist clinic waiting lists. Most referrals were made by general practitioners (GPs) (87%) for LBP (63%) or neck pain (24%).

At the end of the pilot, 292 (55.9%) eligible patients had been reviewed in BAC, 91 (17.4%) accepted but had not yet attended, 68 (13%) declined all services (majority because their spinal symptoms had resolved), 61 (11.7%) were uncontactable, 2 (0.4%) had died and 5 (1%) had already attended an outpatient surgical appointment. Only 3 patients (0.6%) declined a BAC appointment. Of the 292 patients reviewed, complete data were available for 285 (97.6%) patients. Seven were excluded from the analysis due to incorrect or incomplete information. The mean (SD) age of patients seen (n=285) and referred but not seen in BAC (n=230) were 53.9 (16.8) and 53.6 (17) years respectively. The gender distribution in both groups was similar (47.7% and 43.9% males, respectively).

Table 2. Baseline characteristics of patients in the BAC 'seen' and 'not seen' groups.

Variable	'BAC seen' N=285	'BAC, not seen' N=230	Total N=515
Male: n (%)	136 (47.7)	101 (43.9)	237 (46.0)
Age in years at time of referral: mean (SD)	53.9 (16.8)	53.6 (17.0)	53.8 (16.9)
Catchment: n (%)			
Merri CHS*	161 (56.5)	151 (65.7)	312 (60.6)
cohealth	124 (43.5)	79 (34.3)	203 (39.4)
Referral source: n (%)			
General practitioner	250 (87.7)	204 (88.7)	454 (88.2)
Melbourne Health	35 (12.3)	25 (10.9)	60 (11.7)
Other public hospital	0 (0)	1 (0.4)	1 (0.2)

Clinic referred to: n (%)			
Neurosurgery	230 (80.7)	199 (86.5)	429 (83.3)
Orthopaedics	43 (15.1)	25 (10.9)	68 (13.2)
Rheumatology	4 (1.4)	4 (1.7)	8 (1.6)
Pain service	5 (1.8)	1 (0.4)	6 (1.2)
Back pain Assessment Clinic	3 (1.1)	1 (0.4)	4 (0.8)
Already on clinic waiting list, n (%)	121 (42.5)	129 (56.1)	250 (48.5)

Access to Care

For 194 newly referred patients reviewed in BAC, the mean (SD) time from referral to initial consultation was 9.8 (4.3) weeks, including referrals received 3 months prior to BAC's commencement. Of the 119 patients redirected from neurosurgery and orthopaedic outpatient waiting lists, the respective mean (SD) waiting times were 101.3 (42.4) and 70.5 (40.1) weeks (equating to a weighted-average of 100 weeks).

Of GPs who were aware of BAC (n=18), 61% felt BAC had improved access to care, and only two respondents indicated preference for a surgeon seeing their patients. Eight GPs (30.8%) indicated they were unaware of BAC, most likely because BAC was not advertised to GPs during the pilot. Surveyed patients (n=54) rated attending BAC at the community health centre as easier than travelling to RMH's acute hospital campus.

Appropriate and Safe Care

92.8% of patients in BAC were seen by the same clinician throughout their contact with the service, maintaining continuity of care. Following BAC consultation, 34% of patients had medications adjusted, 6% underwent a spinal injection (e.g. nerve root block), 57% were referred for community-based spinal rehabilitation and 6.1% were referred to another specialist service: 5 (1.8%) to Neurosurgery or Orthopaedics, 3 (1.1%) to Rheumatology, 9 (3.2%) to Chronic Pain Services. 53 patients (18.6%) were discharged after their initial BAC consultation. There were no patient complaints nor adverse incidents.

Analysis of available patient-reported outcomes (ODI/NDI, BPI-I/-S, GIS) showed improvements in all domains of disability, pain and overall well-being (Table 3). In terms of patient reported satisfaction, 94.4% of respondents recorded very high levels of satisfaction with the service, engagement with clinicians and clinicians' explanations. Similarly, 94.4% of respondents indicated they were 'very satisfied' (62.9%) or 'satisfied' (31.5%) with the service, 'very satisfied' (68.5%) or 'satisfied' (29.6%) with clinician care and either 'strongly agreed' (66.7%) or 'agreed' (27.8%) that their expectations had been met. Surveyed GPs (n=26) expressed satisfaction with the communication received from BAC ('strongly agreed' 15.4%, 'agreed' 42.3%).

Table 3. Changes in patient-reported outcomes among BAC patients.

Outcome measure	n	Mean (SD)	95% confidence interval*
Oswestry or Neck disability index (%):	33	-7.8 (11.5)	-11.7 to -3.8

change from first visit to latest visit[#]			
Brief Pain Inventory - Severity: change from first visit to last visit[#]	18	-2.1 (2.3)	-1.0 to -3.1
Brief Pain Inventory - Interference: change from first visit to last visit[#]	20	-1.8 (2.5)	-0.7 to -2.9
Global Improvement Scale: maximum category at any subsequent visit	53	5.0 (1.3)	4.6 to 5.3

Mean ± 1.96[SD/√n]
[#]negative value indicates improvement

Workforce Optimisation and Integration

Surveys of stakeholders suggested that BAC promoted more efficient use of surgeons' skills and time. Stakeholders and GPs (61.5%) regarded involving a Rheumatologist in BAC was important for ensuring medical issues were identified and appropriately managed. Stakeholder feedback regarding the role of APP was also positive, although less than 40% of GPs understood their role.

Efficiency and Sustainability

The clinician costs of staffing BAC and traditional Neurosurgery/Orthopaedic clinics are summarised in Table 4. To review 15 patients in a 3.5-hour session, BAC costs $68.60 per patient, compared to $44.80 per patient seen in a surgical clinic, meaning a cost-differential of $23.80 per patient. However, BAC was associated with significant cost savings through reduced MRI ordering. Among the 285 patients seen in BAC, 97 (34%) had already undergone MRI scanning prior to BAC attendance, while a further 18 patients (6.3%) were referred for an MRI after BAC assessment. Compared to standard practice in existing surgical clinics, BAC reduced the proportion of patients having MRI scans from an assumed 89.9% (14) to 40.3% (absolute difference 49.6%), conferring a cost-saving of $180 per patient, or total cost-saving of $52,560 during the pilot.

Table 4. Comparison of clinician costs of staffing BAC and traditional surgical clinics.

	BAC	Neurosurgical/Orthopaedic clinic
Consultants	1 @ $135/hour (HN29, mid-tier)	1 @ $135/hour (HN29, mid-tier)
Registrars	1 @ $57/hour (HM29, upper tier)	1 @ $57/hour (HM29, upper tier)
Advanced practice physiotherapist x 2	$51/hour (VC8, upper tier)	N/A
Number of patients seen per session (3.5 hours)	15	15
Cost per patient seen	$68.60	$44.80

Total staff costs for 3.5 hour session	$1029	$672

DISCUSSION

Evaluation of the BAC pilot demonstrates it is a safe and effective model for managing referrals to hospital services for neck and LBP. BAC is a collaborative initiative that integrates tertiary hospital stakeholders and community health services to deliver more coordinated and efficient care. This was made possible through (i) establishing the BAC clinical pathway that provides patients with streamlined access to community- and hospital-based expertise, (ii) DHHS funding, and (iii) unprecedented cooperation and good will from stakeholders. BAC helped transform typically fragmented and variable care of LBP in current service models and was associated with high levels of patient reported satisfaction.

Establishing BAC as a community- and catchment-based service provided convenient access to tertiary care expertise and improved communication and coordination of care between tertiary and primary care clinicians. This was favourably regarded by stakeholders. The process to establish stakeholder consensus criteria for referral to BAC encouraged confidence that patients were triaged to the most appropriate service and care was not compromised. This was supported by the finding that most referrals (73.7%) were deemed appropriate for BAC and following assessment in BAC, only 1.8% required surgical review. Moreover, there were no adverse patient outcomes. The centralised triage process also provided a single entry point for all referrals for neck and LBP. This allowed the service to 1) 'sort' referrals and triage them to the most appropriate service, 2) consolidate duplicate referrals made to multiple specialties for a single patient, 3) calibrate clinicians from different disciplines in triaging referrals, 4) apply and refine the BAC consensus criteria and 5) regularly hold multidisciplinary case conferencing and share expertise.

BAC was associated with significantly lower MRI utilisation compared to surgical clinics. This translated to a saving of $52,560 during the pilot and a significant opportunity cost of improved MRI access for other patients. Beyond savings in MRI costs, BAC improved patient access to evidence-based care (e.g. patients received care 90 weeks or 1.7 years earlier) and promoted more effective deployment of surgeons' skill and time. Finally, Rheumatology involvement provided the APPs and registrar with specialist support for patient assessment (e.g. requesting and interpreting investigations) and optimising non-surgical management (e.g. analgesia review, performing diagnostic/therapeutic joint injections, referral for spinal nerve blocks). This was favourably regarded by referrers and stakeholders.

There are few studies of models of care for neck and LBP and none have been comprehensively evaluated (6, 15-17). Preliminary evidence from APP-led triage services demonstrate similar trends in improved patient satisfaction, referral practices, reduced waiting times, cost and potentially improved patient outcomes. The BAC model differed in several respects. First, BAC is associated with less risk of missing 'red flags' given these referrals are excluded from BAC (Table 1) and are carefully screened for using a standardised

pro forma during BAC consultation. Second, the centralised triage process is unique to BAC and facilitated standardisation of clinician triage practices. After completion of the pilot, centralised triage was performed by the BAC rheumatologist and APPs. Third, the BAC clinical pathways provided patients with streamlined access to community- and hospital-based services. Fourth, BAC provided more holistic and efficient patient care through involvement of a Rheumatologist to ensure that evidence-based management were adequately trialled and appropriate investigations were organised prior to surgical review. Finally, BAC is one of the first tertiary neck and LBP services to have been established in primary care.

Our study findings are subject to the limitations of an observational study design. Interpretation of the evaluation is restricted by the modest sample size of patient and GP responses, limited economic analysis and absence of long-term follow-up. The BAC model therefore warrants further validation using a rigorous comparative analysis to routine care, ideally in the form a randomised clinical trial. At the time of manuscript submission, the Victorian DHHS has funded replication of the BAC model in three other Victorian hospitals. Evaluation of BAC's implementation at other sites will help further validate the current study findings.

CONCLUSION

The BAC model is a novel care pathway that provides patients with neck and LBP with streamlined access to community-based expert assessment and spinal rehabilitation, as well as hospital-based specialist expertise. The results of this pilot study indicate that BAC is a safe, effective and potentially cost-saving alternative model of care. Evaluation is ongoing to determine the cost-effectiveness, longer-term and broader societal impact of replicating BAC more broadly.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	PAGE 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	PAGE 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	PAGE 4
Objectives	3	State specific objectives, including any prespecified hypotheses	PAGE 4
Methods			
Study design	4	Present key elements of study design early in the paper	PAGES 4-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	PAGES 4-7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	PAGE 6
		Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed	PAGE 8
		Case-control study—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	PAGES 4,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	PAGES 4,8
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	PAGE 8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	PAGE 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	PAGE 8
		(*b*) Describe any methods used to examine subgroups and interactions	PAGE 8
		(*c*) Explain how missing data were addressed	PAGE 8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed	PAGE 8
		Case-control study—If applicable, explain how matching of cases and controls was addressed	
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	N/A

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed PAGE 8
		(b) Give reasons for non-participation at each stage PAGE 8
		(c) Consider use of a flow diagram N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders PAGES 8-9
		(b) Indicate number of participants with missing data for each variable of interest PAGE 8
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) PAGE 5
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time PAGES 8-11
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included PAGES 8-11
		(*b*) Report category boundaries when continuous variables were categorized PAGES 8-11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses PAGE 9
Discussion		
Key results	18	Summarise key results with reference to study objectives PAGE 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias PAGE 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence PAGE 12
Generalisability	21	Discuss the generalisability (external validity) of the study results PAGE 11-12
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based PAGE 1

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Is establishing a specialist back pain assessment and management service in primary care a safe and effective model? Twelve month results from the Back pain Assessment Clinic (BAC) pilot study

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Is establishing a specialist back pain assessment and management service in primary care a safe and effective model? Twelve month results from the Back pain Assessment Clinic (BAC) pilot study.

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Competing Interest Declaration

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Contributorship Statement

Contributors: Study design: JHYM, UP, ADG, DL, TIY, JEC, IPW; data acquisition: JHYM, UP, ADG; data analysis and interpretation: JHYM, UP, ADG, DL, TIY, JEC, IPW; statistical analysis: DL. JHYM takes responsibility that this study has been reported honestly, accurately and transparently and is the study guarantor. All authors (JHYM, UP, ADG, DL, TIY, JEC, IPW) contributed important intellectual content during manuscript drafting and revision, accept accountability for the work and have approved the final version for publication.

Data Sharing Statement

The authors agree to share deidentified participant data reported in the study. Proposals should be directed to the corresponding author. To gain access, data requestors will need to sign a data access agreement. Data will be available for up to 24 months following article publication.

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ABSTRACT

Objectives. To report on the design, implementation and evaluation of the safety and effectiveness of the **B**ack pain **A**ssessment **C**linic (**BAC**) model.

Design. BAC is a new, community-based specialist service for assessing and managing neck and low back pain (LBP). The BAC pilot was supported by a Victorian Department of Health and Human Services grant and was evaluated using the Victorian Innovation Reform Impact Assessment Framework (VIRIAF). Data were obtained by auditing BAC activity (22 July 2014 to 30 June 2015) and conducting surveys and interviews of patients, stakeholders and referrers.

Setting. Tertiary and primary care.

Participants. Adult patients with neck and LBP referred for outpatient surgical consultation.

Main Outcome Measures. VIRIAF outcomes: i) access to care; ii) appropriate and safe care; iii) workforce optimisation and integration; and iv) efficiency and sustainability.

Results. A total of 522 patients were seen during the pilot. Most were referred to hospital services by general practitioners (87%) for LBP (63%) and neck pain (24%). All patients were seen within 10 weeks of referral and commenced community-based allied health intervention within 2-4 weeks of assessment in BAC. Of patients seen, 34% had medications adjusted, 57% were referred for physiotherapy, 3.2% to pain services, 1.1% to rheumatology and 1.8% for surgical review. Less MRI scans were ordered in BAC (6.4%) compared to traditional spinal surgical clinics (89.8%), which translated to a cost-saving of $52,560 over 12-months. Patient and staff satisfaction was high. There have been no patient complaints or adverse incidents.

Conclusion. Evaluation of the BAC pilot suggests it is a potentially safe and cost-saving alternative model of care. Results of the BAC pilot merit further evaluation to determine the potential cost-effectiveness, longer-term and broader societal impact of implementing BAC more widely.

Study Strengths

- One of the first studies to evaluate the outcomes of patients managed in a primary care based specialist service for assessing and managing neck and low back pain referrals to public hospitals, including patient reported functional outcomes and patient, clinician, and referrer satisfaction.
- Longer duration of patient cohort follow up compared with other studies of alternative care models for neck and low back pain.
- More substantial cost-effective analysis than provided by other studies of alternative models of care for neck and low back pain.

Study Limitations

- Our study findings are subject to the limitations of an observational study design.

- Interpretation of the evaluation is restricted by the modest sample size of patient and GP responses, limited economic analysis, absence of long-term follow-up and our study lacked a historical comparator group.

INTRODUCTION

Worldwide, low back pain (LBP) and neck pain are the most prevalent and disabling musculoskeletal conditions in the community (1, 2) and affects people of all ages in high-, middle-, and low-income countries (3). LBP, in particular, places great demands on primary care (4) and hospital resources (5-7). It is the leading musculoskeletal complaint seen in both general practice (4) and hospital emergency departments (7), and U.K. Hospital Episode Statistics report that the rates of hospitalisation and inpatient procedures performed for LBP have significantly risen, by 2.3- and 2.8-fold respectively, in recent years (8). Similarly, the 2009-2010 National Health and Nutrition Examination Survey (NHANES) found that compared to individuals without LBP, adults with chronic LBP (cLBP) in the U.S. were 3.3 times more likely to report ≥10 visits to healthcare providers and overnight hospitalization per annum (9).

Although most guidelines recommend that LBP should be managed in primary care, many patients are still referred for outpatient surgical review (10-12). High referral rates are associated with lengthy waits for initial consultation and delays in care for appropriate candidates for surgery (10). For example, our institution, The Royal Melbourne Hospital (RMH), is a large Australian metropolitan public hospital with over 500 inpatient beds and serves as a tertiary neurosurgery and orthopaedic referral centre. An audit of the neurosurgery outpatient waiting list in 2013 revealed that 68.5% of all 'non-urgent' referrals (971 of 1,418) were made for neck or LBP, and the mean wait time for an initial consultation was 18 months (12). Other factors identified as contributing to delays in care within the existing system (shown in ***Figure 1***), include the lack of appropriate conservative management prior to referral for specialist consultation, referral of patients to multiple specialist services for the same problem, which further compound lengthy waits to accessing specialists; the lack of streamlined care pathways between different specialist services within hospitals and between tertiary and primary care, and the fact that the vast majority (≥90%) of patients referred to surgical clinics do not require surgery (10, 13) but are discharged without referral for conservative management (12).

Alternative models of care are therefore needed that provide patients with more timely access to expert assessment and evidence-based management. The aim of this study was to report on the design, implementation and initial evaluation of a novel care model, called the '**B**ack pain **A**ssessment **C**linic' (**BAC**), which was established as an alternative pathway for providing community-based, outpatient specialist review of neck and LBP.

METHODS

Back pain Assessment Clinic (BAC) Model and Pilot

The BAC model and care pathways were developed as a collaborative initiative between Rheumatology, Neurosurgery, Orthopaedics, Chronic Pain and Physiotherapy services at RMH to provide patients within RMH's primary catchment area with rapid access to community-based specialist care for neck and LBP. Weekly clinics were established at a community health centre (Merri Health, MH) and RMH's Royal Park (subacute) campus (RPC). BAC was staffed by advanced practice physiotherapists (APP) and a rheumatology registrar who worked under the guidance of a rheumatologist. The APPs were senior physiotherapists who had postgraduate qualifications, credentialing in advanced practice (14) and extensive experience in spinal surgery clinics.

A 'centralised triage process' was developed to support BAC's implementation. This involved a Rheumatologist (JM), Neurosurgeon (TY), Orthopaedic Spinal Surgeon (JC) and APP (UP) meeting fortnightly to triage new referrals for spinal pain either to BAC or the appropriate outpatient specialist clinic. Consensus criteria were established regarding the conditions which were suitable for BAC (Table 1). In general, referrals were excluded from BAC if surgery was considered highly likely or 'red flag' causes of neck and LBP were present; the latter were escalated for rapid specialist consultation.

Patients and referrers were sent written information about the BAC pilot prior to being offered an appointment. All patients provided verbal consent to participating in the pilot. Patients were assessed in BAC within 10 weeks of referral. Prior to BAC consultation, patients received a questionnaire that collected information on demographics, medical history, Brief Pain Inventory (BPI) short form (15), and Oswestry Disability Index (ODI) (16) or Neck Disability Index (NDI) scores (17). In BAC, patients were clinically assessed and screened for 'red flags', questionnaire responses were reviewed and an evidence-based management plan was developed, which included a review of patient analgesia. Patients requiring active exercise intervention were referred and seen within 2-4 weeks in newly developed community-based spinal rehabilitation programs (MH, Cohealth). Patients requiring Neurosurgery, Orthopaedic Spinal Surgery, Rheumatology or Chronic Pain services were seen within 12 weeks with appropriate investigations arranged (***Figure 2***). After completing the 12-week community-based spinal rehabilitation program, patients were reassessed using the ODI/NDI, BPI (-I: interference, -S: severity) and Global Improvement Scale (GIS) (18).

The BAC pilot ran from 22 July 2014 to 30 June 2015, funded by a Workforce Innovation Grant from the Victorian Department of Health and Human Services (DHHS). Appropriate patients within RMH's primary catchment area already on the outpatient surgical waiting lists were also offered a BAC appointment. The assessment (BAC) and management clinics (MH) became known collectively as the '**B**ack pain **A**ssessment and **M**anagement **S**ervice' (**BAMS**).

174 ***Table 1. Consensus inclusion and exclusion criteria for BAC.***

Inclusion Criteria • New and existing referrals for neck or LBP already on outpatient spinal surgical waiting lists. • Referrals for patients that live within the hospital's primary catchment area*. • Referrals triaged 'non-urgent' or assigned a 'next available' appointment by neurosurgery and orthopaedic spinal units. • Spinal pain with or without referred limb symptoms. • Absence of 'red flags'. • Low likelihood of surgical intervention. • Age greater than 16 years.
Exclusion Criteria • Radiological or clinical features confirming or raising the suspicion of 'red flags' e.g. spinal infection, malignancy, fracture, spinal inflammation, spinal cord compression (e.g. cervical myelopathy) or cauda equina syndrome. • Spinal trauma, instability (e.g. atlantoaxial instability), recent spinal fracture or spinal surgery within the last 2 years. • Brain or spinal cord injury or malformation. • Radiological evidence of moderate-to-severe central canal stenosis, lateral recess or foraminal stenosis, or a large disc protrusion accompanied by signs and symptoms of radiculopathy or neurogenic claudication. • Worsening upper or lower motor neuron deficits. • Radiculopathy accompanied by limb weakness e.g. foot drop. • Moderate-to-severe scoliosis with Cobb angle >20 degrees. • Peripheral entrapment neuropathies e.g. carpal tunnel syndrome. • High likelihood of need for surgical intervention. • Failed adequate trial of non-operative management for a potentially surgically amenable condition (e.g. spondylolisthesis with persistent symptoms). • Presence of a comorbid condition that also requires surgical assessment and management. • Referral from another hospital surgeon or physician to neurosurgery or orthopaedic spinal surgery. • Patients already well-known to neurosurgery, orthopaedics, rheumatology or chronic pain services. • Referrals for consideration of spinal surgical device implantation (e.g. spinal cord stimulators). • Patient and/or GP preference for patients to be assessed by a surgeon. • Patients referred for medicolegal opinions or compensable claims e.g. Transport Accident Commission (TAC), WorkSafe Victoria.

*Catchment area refers to the geographical area surrounding the hospital, from which patients are eligible to use its services.

Evaluation Framework, Study Outcomes and Data Collection

BAC was evaluated using the Victorian Innovation Reform Impact Assessment Framework (VIRIAF) (19), in line with Victorian DHHS requirements. Key areas of evaluation were: i) access to care; ii) appropriate and safe care; iii) workforce optimisation and integration; and iv) efficiency and sustainability. The four domains of the VIRIAF served as the primary study outcomes for the BAC pilot.

Quantitative data were obtained from auditing the centralised triage process and BAC activity from 22 July 2014 to 30 June 2015. Qualitative data were collected from surveys and interviews of patients (n=54), stakeholders (includes Neurosurgeons, Orthopaedic surgeons, Rheumatologists, hospital and community health managers and Physiotherapists) (n=14) and referrers (n=26) between 1 March 2015 and 30 June 2015 (***Table 2***). The BAC pilot evaluation was approved by the Melbourne Health Human Research Ethics Committee (QA2014148).

Table 2. Study outcomes as defined by the four domains of the Victorian Innovation Reform Impact Assessment Framework (VIRIAF) and the data sources and collection methods used.

VIRIAF Domains	Outcomes	Data Sources & Collection Methods*
Access to Care	• Patients receive timely access to expert management of low back and neck pain. • Patients receive convenient access to services within their local community. • Patients receive timely access to specialist surgical, rheumatology, chronic pain management and allied health services where indicated through newly developed and streamlined referral pathways of care.	• Clinic audit • Patient survey & interview • Referrer survey & interview • Stakeholder interview
Appropriate & safe care	• Patients with back or neck pain are directed to the most appropriate clinical service, including appropriate non-surgical management for those who either do not require or are unlikely to benefit from spinal surgery. • Patients redirected from neurosurgery, orthopaedic spinal, rheumatology and pain services experience no adverse outcomes. • Patients receive appropriate clinical services based on need and clinical evidence. • Patients experience continuity of care.	• Clinic and triage audit • Audit of hospital administrative data • Patient survey & interview • Referrer survey & interview • Stakeholder interview • Clinician survey & interview
Workforce optimisation & integration	• Service development and delivery involves multidisciplinary and cross-organisational collaboration, which also contributes to ongoing knowledge and skill development. • Surgeon time and skills are optimised	• Clinician survey & interview • Referrer survey & interview • Stakeholder interview

	towards assessing and managing patients with back or neck problems that are more likely to benefit from surgery and for conditions that are more time critical. • Advanced practice physiotherapist's and rheumatologist's skills are optimally used to assess and manage patients with back and neck pain. • The community health workforce capacity is expanded to include management of more complex patients with back and neck pain.	• Patient survey & interview
Efficiency & sustainability	• Cost-effective management of patients with low back or neck pain is demonstrated. • Service replicability and sustainability are demonstrated.	• Clinic and triage audit • Audit of hospital administrative data • Clinician survey & interview • Stakeholder interview • Use of MRIs and CTs

*Apart from the collection of patient surveys, which was conducted during the BAC pilot, all other data collection was performed at the conclusion of the 12-month pilot project.

Statistical Methods

Descriptive data were summarised using mean (SD) or median (IQR) for continuous variables and n (%) for categorical variables. Data on referral sources and waiting times were analysed for the whole cohort, while health services utilisation was analysed according to two subgroups: i) patients referred to and reviewed in BAC; and ii) patients referred to but not reviewed in BAC. Magnetic resonance imaging (MRI) costs were calculated using the Medicare Benefits Schedule (MBS) fee of $358.40 for spinal MRI (item numbers 63161, 63164, 63167, 63170, 63173, 63176, 63179, 63182, 63185), and the MRI utilisation rates in outpatient neurosurgery clinics for assessing spinal conditions was assumed to be 89.8% in line with published data (20). A p value <0.05 was considered statistically significant. All analyses were performed using SPSS, version 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows. Armonk, NY, USA).

Patient and Public Involvement

A steering committee was formed to oversee the BAC pilot and included consumer representation. The consumer representative provided input on the research question, development of patient and referrer study information sheets, patient questionnaires used for data collection, and study evaluation. Results from the BAC pilot were made available to study participants that requested a copy of the research findings.

RESULTS

Study Population

Patient demographics are summarised in ***Table 3***. The majority (73.7%) of new referrals to RMH surgical clinics were deemed appropriate for BAC by the centralised triage team. In

total, 522 in-catchment patients were referred to BAC (83.3% re-directed from neurosurgery, 13.2% from orthopaedics), of whom 51.5% (n=272) were new referrals and 48.5% (n=250) were drawn from specialist clinic waiting lists. Most referrals were made by general practitioners (GPs) (87%) for LBP (63%) or neck pain (24%).

At the end of the pilot, 292 (55.9%) eligible patients had been reviewed in BAC (designated the BAC 'seen' group). Of the remaining 230 patients (designated the BAC 'not seen' group), 91 (17.4%) accepted but had not yet attended, 68 (13%) declined all services (the majority because their spinal symptoms had resolved), 61 (11.7%) were uncontactable, 2 (0.4%) had died and 5 (1%) had already attended an outpatient surgical appointment. Only 3 patients (0.6%) declined a BAC appointment. Of the 292 patients reviewed, complete data were available for 285 (97.6%) patients. Seven were excluded from the analysis due to incorrect or incomplete information. The mean (SD) age of patients seen (n=285) and referred but not seen in BAC (n=230) were 53.9 (16.8) and 53.6 (17) years respectively. The gender distribution in both groups was similar (47.7% and 43.9% males, respectively).

Table 3. Baseline characteristics of patients in the BAC 'seen' and 'not seen' groups.

Variable	'BAC seen' N=285	'BAC, not seen' N=230	Total N=515
Male: n (%)	136 (47.7)	101 (43.9)	237 (46.0)
Age in years at time of referral: mean (SD)	53.9 (16.8)	53.6 (17.0)	53.8 (16.9)
Catchment: n (%)			
Merri CHS*	161 (56.5)	151 (65.7)	312 (60.6)
cohealth	124 (43.5)	79 (34.3)	203 (39.4)
Referral source: n (%)			
General practitioner	250 (87.7)	204 (88.7)	454 (88.2)
Melbourne Health	35 (12.3)	25 (10.9)	60 (11.7)
Other public hospital	0 (0)	1 (0.4)	1 (0.2)
Clinic referred to: n (%)			
Neurosurgery	230 (80.7)	199 (86.5)	429 (83.3)
Orthopaedics	43 (15.1)	25 (10.9)	68 (13.2)
Rheumatology	4 (1.4)	4 (1.7)	8 (1.6)
Pain service	5 (1.8)	1 (0.4)	6 (1.2)
Back pain Assessment Clinic	3 (1.1)	1 (0.4)	4 (0.8)
Already on clinic waiting list, n (%)	121 (42.5)	129 (56.1)	250 (48.5)

Access to Care

For 194 newly referred patients reviewed in BAC, the mean (SD) time from referral to initial consultation was 9.8 (4.3) weeks, including referrals received 3 months prior to BAC's commencement. Of the 119 patients redirected from neurosurgery and orthopaedic outpatient waiting lists, the respective mean (SD) waiting times were 101.3 (42.4) and 70.5 (40.1) weeks (equating to a weighted-average of 100 weeks).

Of GPs who were aware of BAC (n=18), 61% felt BAC had improved access to care, and only two respondents indicated a preference for a surgeon to see their patients. Eight GPs (30.8%) indicated they were unaware of BAC, most likely because BAC was not advertised to GPs during the pilot. Surveyed patients (n=54) rated attending BAC at the community health centre as easier than travelling to RMH's acute hospital campus.

Appropriate and Safe Care

92.8% of patients in BAC were seen by the same clinician throughout their contact with the service, maintaining continuity of care. Following BAC consultation, 34% of patients had medications adjusted, 6% underwent a spinal injection (e.g. nerve root block), 57% were referred for community-based spinal rehabilitation and 6.1% were referred to another specialist service: 5 (1.8%) to Neurosurgery or Orthopaedics, 3 (1.1%) to Rheumatology, 9 (3.2%) to Chronic Pain Services. 53 patients (18.6%) were discharged after their initial BAC consultation. There were no patient complaints nor adverse incidents.

Analysis of available patient-reported outcomes (ODI/NDI, BPI-I/-S, GIS) showed improvements in all domains of disability, pain and overall well-being (***Table 4***). In terms of patient reported satisfaction, 94.4% of respondents recorded very high levels of satisfaction with the service, engagement with clinicians and clinicians' explanations. Similarly, 94.4% of respondents indicated they were 'very satisfied' (62.9%) or 'satisfied' (31.5%) with the service, 'very satisfied' (68.5%) or 'satisfied' (29.6%) with clinician care and either 'strongly agreed' (66.7%) or 'agreed' (27.8%) that their expectations had been met. Surveyed GPs (n=26) expressed satisfaction with the communication received from BAC ('strongly agreed' 15.4%, 'agreed' 42.3%).

Table 4. Changes in patient-reported outcomes among BAC patients.

Outcome measure	n	Mean (SD)	95% confidence interval*
Oswestry or Neck disability index (%): change from first visit to latest visit[#]	33	-7.8 (11.5)	-11.7 to -3.8
Brief Pain Inventory - Severity: change from first visit to last visit[#]	18	-2.1 (2.3)	-1.0 to -3.1
Brief Pain Inventory - Interference: change from first visit to last visit[#]	20	-1.8 (2.5)	-0.7 to -2.9
Global Improvement Scale: maximum category at any subsequent visit	53	5.0 (1.3)	4.6 to 5.3

Mean ± 1.96[SD/√n]

[#]negative value indicates improvement

Workforce Optimisation and Integration

Surveys of stakeholders suggested that BAC promoted more efficient use of surgeons' skills and time. Stakeholders and GPs (61.5%) regarded involving a Rheumatologist in BAC was important for ensuring medical issues were identified and appropriately managed. Stakeholder feedback regarding the role of APP was also positive, although less than 40% of GPs felt they understood their role.

Efficiency and Sustainability

The clinician costs of staffing BAC and traditional Neurosurgery/Orthopaedic clinics are summarised in ***Table 5***. To review 15 patients in a 3.5-hour session, BAC costs $68.60 per patient, compared to $44.80 per patient seen in a surgical clinic, meaning a cost-differential of $23.80 per patient. However, BAC was associated with substantial cost savings through reduced MRI usage. Among the 285 patients seen in BAC, 97 (34%) had already undergone MRI scanning prior to BAC attendance, while a further 18 patients (6.3%) were referred for an MRI after BAC assessment. Compared to standard practice in existing surgical clinics, BAC reduced the proportion of patients having MRI scans from an assumed 89.8% (20) to 40.3% (absolute difference 49.5%), conferring a cost-saving of $180 per patient, or total cost-saving of $52,560 during the pilot.

Table 5. Comparison of clinician costs of staffing BAC and traditional surgical clinics.

	BAC	Neurosurgical/Orthopaedic clinic
Consultants	1 @ $135/hour (HN29, mid-tier)	1 @ $135/hour (HN29, mid-tier)
Registrars	1 @ $57/hour (HM29, upper tier)	1 @ $57/hour (HM29, upper tier)
Advanced practice physiotherapist x 2	$51/hour (VC8, upper tier)	N/A
Number of patients seen per session (3.5 hours)	15	15
Cost per patient seen	$68.60	$44.80
Total staff costs for 3.5 hour session	$1029	$672

DISCUSSION

Evaluation of the BAC pilot demonstrates it is a potentially safe and effective model for managing referrals to hospital services for neck and LBP. BAC is a collaborative initiative that integrates tertiary hospital stakeholders and community health services to deliver more coordinated and efficient care. This was made possible through (i) establishing the BAC clinical pathway that provides patients with streamlined access to community- and hospital-based expertise, (ii) DHHS funding, and (iii) unprecedented cooperation and good will from stakeholders. BAC helped transform typically fragmented and variable care of LBP in current service models and was associated with high levels of patient reported satisfaction.

Establishing BAC as a community- and catchment-based service provided convenient access to tertiary care expertise and improved communication and coordination of care between tertiary and primary care clinicians. This was favourably regarded by stakeholders. The

process to establish stakeholder consensus criteria for referral to BAC encouraged confidence that patients were triaged to the most appropriate service and care was not compromised. This was supported by the finding that most referrals (73.7%) were deemed appropriate for BAC and following assessment in BAC, only 1.8% required surgical review. Moreover, there were no adverse patient outcomes. The centralised triage process also provided a single entry point for all referrals for neck and LBP. This allowed the service to 1) 'sort' referrals and triage them to the most appropriate service, 2) consolidate duplicate referrals made to multiple specialties for a single patient, 3) calibrate clinicians from different disciplines in triaging referrals, 4) apply and refine the BAC consensus criteria and 5) regularly hold multidisciplinary case conferencing and share expertise.

BAC was associated with substantially lower MRI utilisation compared to surgical clinics. This translated to a saving of $52,560 during the pilot and a substantial opportunity cost of improved MRI access for other patients. Beyond savings in MRI costs, BAC improved patient access to evidence-based care (e.g. patients received care 90 weeks or 1.7 years earlier) and promoted more effective deployment of surgeons' skill and time. Finally, Rheumatology involvement provided the APPs and registrar with specialist support for patient assessment (e.g. requesting and interpreting investigations) and optimising non-surgical management (e.g. analgesia review, performing diagnostic/therapeutic joint injections, referral for spinal nerve blocks). This was favourably regarded by referrers and stakeholders.

There are few studies of models of care for neck and LBP and none have been comprehensively evaluated (11, 13, 21, 22). Preliminary evidence from APP-led triage services from Australia (22), the U.S. (21) and Canada (11, 13) demonstrate similar trends in improved patient satisfaction, referral practices, reduced waiting times, cost and potentially improved patient outcomes. The BAC model differed in several respects. First, BAC is likely to have less risk of missing 'red flags' given these referrals are excluded from BAC (Table 1) and are carefully screened for using a standardised pro forma during BAC consultation. Second, the centralised triage process is unique to BAC and facilitated standardisation of clinician triage practices. After completion of the pilot, centralised triage was performed by the BAC rheumatologist and APPs. Third, the BAC clinical pathways provided patients with streamlined access to community- and hospital-based services. Fourth, BAC provided more holistic and efficient patient care through involvement of a Rheumatologist to ensure that evidence-based management was adequately trialled and appropriate investigations were organised prior to surgical review. Finally, BAC is one of the first tertiary neck and LBP services to have been established in primary care.

Our study findings are subject to the limitations of an observational study design. Interpretation of the evaluation is restricted by the modest sample size of patient and GP responses, limited economic analysis (including omission of the central triage process staffing costs), absence of long-term follow-up and our study lacked a historical comparator group. We were also unable to track the progress of patients who had been directly triaged to attend specialist consultation rather than BAC, which if known, may have provided a more complete picture of the effect of the BAC model, particularly the central triage process. The BAC model therefore warrants further validation using a rigorous comparative analysis to routine care, ideally in the form a randomised clinical trial. At the time of manuscript

submission, the Victorian DHHS has funded replication of the BAC model in three other Victorian hospitals. Evaluation of BAC's implementation at other sites will help further validate findings from the pilot study.

CONCLUSION

The BAC model is a novel care pathway that provides patients with neck and LBP with streamlined access to community-based expert assessment and spinal rehabilitation, as well as hospital-based specialist expertise. The results of this pilot study suggest that BAC is a potentially safe and cost-saving alternative model of care, associated with substantial reductions in MRI usage compared with traditional surgical clinics. The initial findings from the BAC pilot merit further evaluation to determine the cost-effectiveness, longer-term and broader societal impact of implementing BAC more widely.

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Figure 1. Traditional/existing service model in most Australian hospitals for managing outpatient referrals for specialist care of low back and neck pain.

Figure 2. Health service redesign for managing low back and neck pain referrals implemented during the BAC pilot.

Figure 1. Traditional/existing service model in most Australian hospitals for managing outpatient referrals for specialist care of low back and neck pain.

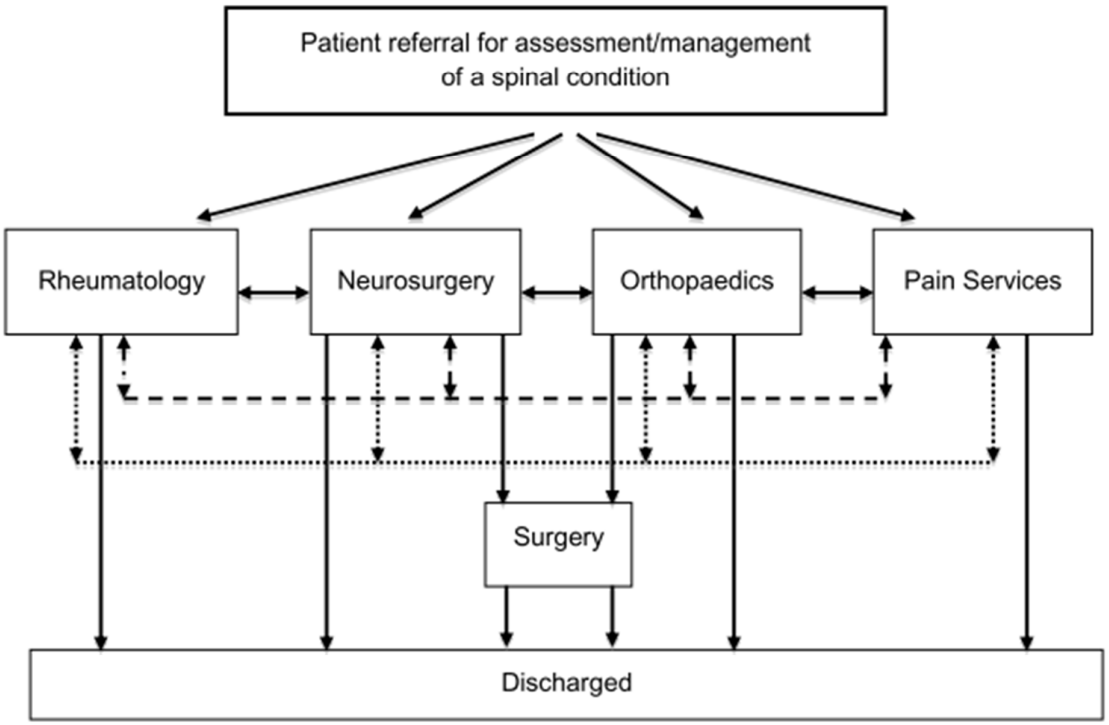
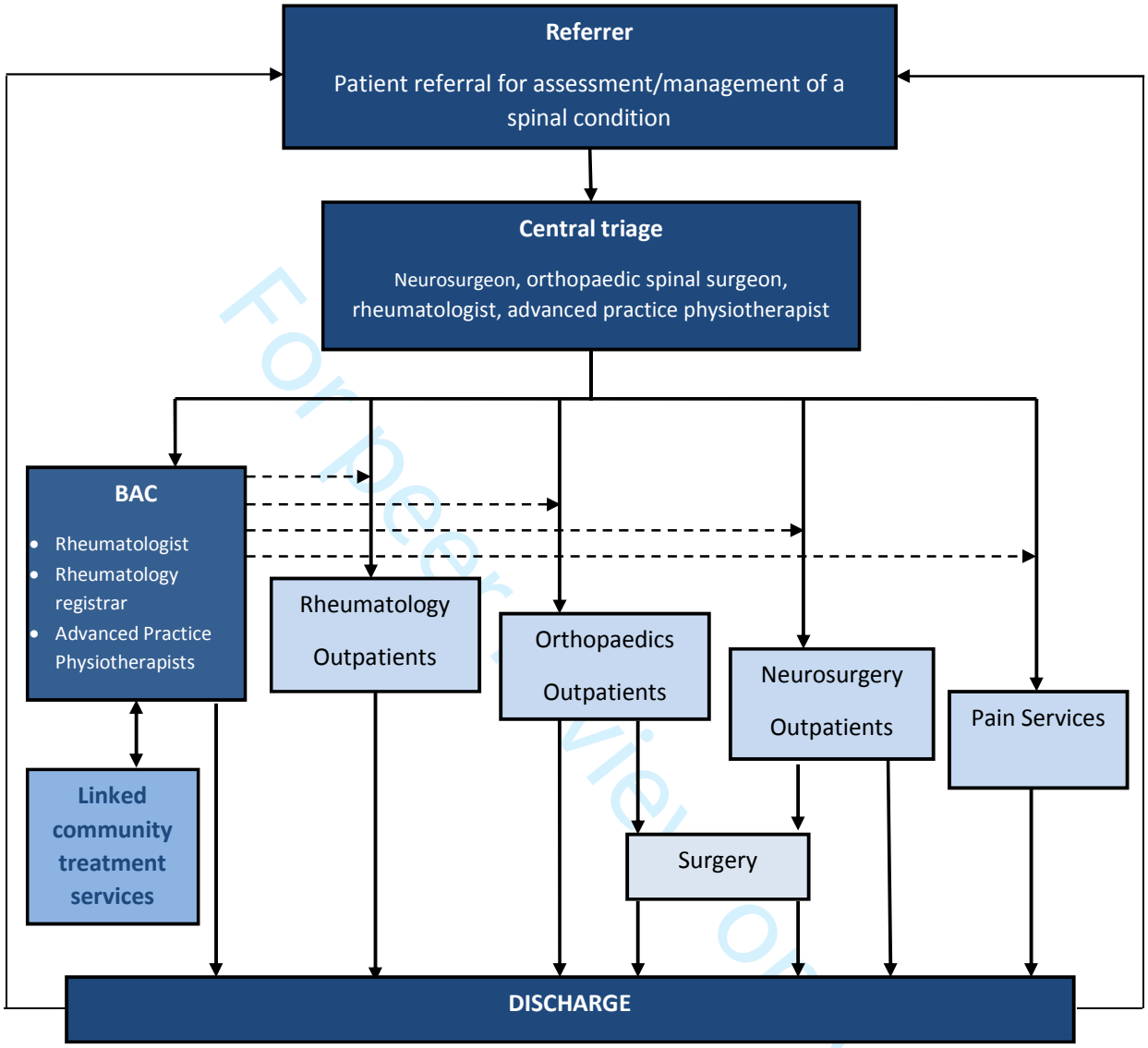


Figure 1. Health service redesign for managing low back and neck pain referrals implemented during the BAC pilot.



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract **[PAGES 1, 3]**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **[PAGE 3]**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **[PAGE 5]**
Objectives	3	State specific objectives, including any prespecified hypotheses **[PAGE 5]**
Methods		
Study design	4	Present key elements of study design early in the paper **[PAGES 5-11]**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **[PAGES 5-11]**
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up **[PAGES 6-9]** *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed **[N/A]** *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **[PAGES 9-10]**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **[PAGES 9-10]**
Bias	9	Describe any efforts to address potential sources of bias **[PAGE 15]**
Study size	10	Explain how the study size was arrived at **[PAGE 11]**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why **[PAGE 11]**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **[PAGE 11]**
		(*b*) Describe any methods used to examine subgroups and interactions **[N/A]**
		(*c*) Explain how missing data were addressed **[PAGE 11]**
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed **[N/A]** *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses **[N/A]**

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **[PAGE 11]**
		(b) Give reasons for non-participation at each stage **[PAGE 11]**
		(c) Consider use of a flow diagram **[N/A]**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **[PAGES 11-12]**
		(b) Indicate number of participants with missing data for each variable of interest **[PAGE 11]**
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) **[PAGE 6]**
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time **[PAGES 12-14]**
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **[PAGES 12-14]**
		(*b*) Report category boundaries when continuous variables were categorized **[PAGES 12-14]**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **[N/A]**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **[N/A]**
Discussion		
Key results	18	Summarise key results with reference to study objectives **[PAGES 3, 14-15]**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **[PAGE 15]**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **[PAGES 14-15]**
Generalisability	21	Discuss the generalisability (external validity) of the study results **[PAGES 14-15]**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **[PAGE 6]**

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Is establishing a specialist back pain assessment and management service in primary care a safe and effective model? Twelve month results from the Back pain Assessment Clinic (BAC) prospective cohort pilot study

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Is establishing a specialist back pain assessment and management service in primary care a safe and effective model? Twelve month results from the Back pain Assessment Clinic (BAC) prospective cohort pilot study.

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Competing Interest Declaration

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare that the submitted work was supported by a workforce innovation grant [ADD/14/7009] provided by the Victorian Department of Health and Human Services. JHYM has received support for conference travel from Abbvie and Pfzier, and honoraria from Abbvie, Janssen and Pfizer. JEC has received consultancy fees from Emerging Implant Technologies GmbH and Medtronic Australasia.

Contributorship Statement

Contributors: Study design: JHYM, UP, ADG, DL, TIY, JEC, IPW; data acquisition: JHYM, UP, ADG; data analysis and interpretation: JHYM, UP, ADG, DL, TIY, JEC, IPW; statistical analysis: DL. JHYM takes responsibility that this study has been reported honestly, accurately and transparently and is the study guarantor. All authors (JHYM, UP, ADG, DL, TIY, JEC, IPW) contributed important intellectual content during manuscript drafting and revision, accept accountability for the work and have approved the final version for publication.

Data Sharing Statement

The authors agree to share deidentified participant data reported in the study. Proposals should be directed to the corresponding author. To gain access, data requestors will need to sign a data access agreement. Data will be available for up to 24 months following article publication.

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ABSTRACT

Objectives. To report on the design, implementation and evaluation of the safety and effectiveness of the **B**ack pain **A**ssessment **C**linic (**BAC**) model.

Design. BAC is a new, community-based specialist service for assessing and managing neck and low back pain (LBP). The BAC pilot was supported by a Victorian Department of Health and Human Services grant and was evaluated using the Victorian Innovation Reform Impact Assessment Framework (VIRIAF). Data were obtained by auditing BAC activity (22 July 2014 to 30 June 2015) and conducting surveys and interviews of patients, stakeholders and referrers.

Setting. Tertiary and primary care.

Participants. Adult patients with neck and LBP referred for outpatient surgical consultation.

Main Outcome Measures. VIRIAF outcomes: i) access to care; ii) appropriate and safe care; iii) workforce optimisation and integration; and iv) efficiency and sustainability.

Results. A total of 522 patients were seen during the pilot. Most were referred to hospital services by general practitioners (87%) for LBP (63%) and neck pain (24%). All patients were seen within 10 weeks of referral and commenced community-based allied health intervention within 2-4 weeks of assessment in BAC. Of patients seen, 34% had medications adjusted, 57% were referred for physiotherapy, 3.2% to pain services, 1.1% to rheumatology and 1.8% for surgical review. Less MRI scans were ordered in BAC (6.4%) compared to traditional spinal surgical clinics (89.8%), which translated to a cost-saving of $52,560 over 12-months. Patient and staff satisfaction was high. There have been no patient complaints or adverse incidents.

Conclusion. Evaluation of the BAC pilot suggests it is a potentially safe and cost-saving alternative model of care. Results of the BAC pilot merit further evaluation to determine the potential cost-effectiveness, longer-term and broader societal impact of implementing BAC more widely.

Study Strengths

- One of the first studies to evaluate the outcomes of patients managed in a primary care based specialist service for assessing and managing neck and low back pain referrals to public hospitals, including patient reported functional outcomes and patient, clinician, and referrer satisfaction.
- Longer duration of patient cohort follow up compared with other studies of alternative care models for neck and low back pain.
- More substantial cost-effective analysis than provided by other studies of alternative models of care for neck and low back pain.

Study Limitations

- Our study findings are subject to the limitations of an observational study design.

- Interpretation of the evaluation is restricted by the modest sample size of patient and GP responses, limited economic analysis, absence of long-term follow-up and our study lacked a historical comparator group.

INTRODUCTION

Worldwide, low back pain (LBP) and neck pain are the most prevalent and disabling musculoskeletal conditions in the community (1, 2) and affects people of all ages in high-, middle-, and low-income countries (3). LBP, in particular, places great demands on primary care (4) and hospital resources (5-7). It is the leading musculoskeletal complaint seen in both general practice (4) and hospital emergency departments (7), and U.K. Hospital Episode Statistics report that the rates of hospitalisation and inpatient procedures performed for LBP have significantly risen, by 2.3- and 2.8-fold respectively, in recent years (8). Similarly, the 2009-2010 National Health and Nutrition Examination Survey (NHANES) found that compared to individuals without LBP, adults with chronic LBP (cLBP) in the U.S. were 3.3 times more likely to report ≥10 visits to healthcare providers and overnight hospitalization per annum (9).

Although most guidelines recommend that LBP should be managed in primary care, many patients are still referred for outpatient surgical review (10, 11). High referral rates are associated with lengthy waits for initial consultation and delays in care for appropriate candidates for surgery (10). For example, our institution, The Royal Melbourne Hospital (RMH), is a large Australian metropolitan public hospital with over 500 inpatient beds and serves as a tertiary neurosurgery and orthopaedic referral centre. An audit of the neurosurgery outpatient waiting list in 2013 revealed that 68.5% of all 'non-urgent' referrals (971 of 1,418) were made for neck or LBP, and the mean wait time for an initial consultation was 18 months. Other factors identified as contributing to delays in care within the existing system (shown in ***Figure 1*** ~~***Figure 1***~~), include the lack of appropriate conservative management prior to referral for specialist consultation, referral of patients to multiple specialist services for the same problem, which further compound lengthy waits to accessing specialists; the lack of streamlined care pathways between different specialist services within hospitals and between tertiary and primary care, and the fact that the vast majority (≥90%) of patients referred to surgical clinics do not require surgery (10, 12) but are discharged without referral for conservative management.

Alternative models of care are therefore needed that provide patients with more timely access to expert assessment and evidence-based management. The aim of this study was to report on the design, implementation and initial evaluation of a novel care model, called the '**B**ack pain **A**ssessment **C**linic' (**BAC**), which was established as an alternative pathway for providing community-based, outpatient specialist review of neck and LBP.

METHODS

Back pain Assessment Clinic (BAC) Model and Pilot

The BAC model and care pathways were developed as a collaborative initiative between Rheumatology, Neurosurgery, Orthopaedics, Chronic Pain and Physiotherapy services at RMH to provide patients within RMH's primary catchment area with rapid access to community-based specialist care for neck and LBP. Weekly clinics were established at a community health centre (Merri Health, MH) and RMH's Royal Park (subacute) campus (RPC). BAC was staffed by advanced practice physiotherapists (APP) and a rheumatology registrar who worked under the guidance of a rheumatologist. The APPs were senior physiotherapists who had postgraduate qualifications, credentialing in advanced practice (13) and extensive experience in spinal surgery clinics.

A 'centralised triage process' was developed to support BAC's implementation. This involved a Rheumatologist (JM), Neurosurgeon (TY), Orthopaedic Spinal Surgeon (JC) and APP (UP) meeting fortnightly to triage new referrals for spinal pain either to BAC or the appropriate outpatient specialist clinic. Consensus criteria were established regarding the conditions which were suitable for BAC (Table 1). In general, referrals were excluded from BAC if surgery was considered highly likely or 'red flag' causes of neck and LBP were present; the latter were escalated for rapid specialist consultation.

Patients and referrers were sent written information about the BAC pilot prior to being offered an appointment. All patients provided verbal consent to participating in the pilot. Patients were assessed in BAC within 10 weeks of referral. Prior to BAC consultation, patients received a questionnaire that collected information on demographics, medical history, Brief Pain Inventory (BPI) short form (14), and Oswestry Disability Index (ODI) (15) or Neck Disability Index (NDI) scores (16). In BAC, patients were clinically assessed and screened for 'red flags', questionnaire responses were reviewed and an evidence-based management plan was developed, which included a review of patient analgesia. Patients requiring active exercise intervention were referred and seen within 2-4 weeks in newly developed community-based spinal rehabilitation programs (MH, Cohealth). Patients requiring Neurosurgery, Orthopaedic Spinal Surgery, Rheumatology or Chronic Pain services were seen within 12 weeks with appropriate investigations arranged (***Figure 2*** ~~***Figure 2***~~). After completing the 12-week community-based spinal rehabilitation program, patients were reassessed using the ODI/NDI, BPI (-I: interference, -S: severity) and Global Improvement Scale (GIS) (17).

The BAC pilot ran from 22 July 2014 to 30 June 2015, funded by a Workforce Innovation Grant from the Victorian Department of Health and Human Services (DHHS). Appropriate patients within RMH's primary catchment area already on the outpatient surgical waiting lists were also offered a BAC appointment. The assessment (BAC) and management clinics (MH) became known collectively as the '**B**ack pain **A**ssessment and **M**anagement **S**ervice' (**BAMS**).

Table 1. Consensus inclusion and exclusion criteria for BAC.

Inclusion Criteria
• New and existing referrals for neck or LBP already on outpatient spinal surgical waiting lists. • Referrals for patients that live within the hospital's primary catchment area*. • Referrals triaged 'non-urgent' or assigned a 'next available' appointment by neurosurgery and orthopaedic spinal units. • Spinal pain with or without referred limb symptoms. • Absence of 'red flags'. • Low likelihood of surgical intervention. • Age greater than 16 years.
Exclusion Criteria
• Radiological or clinical features confirming or raising the suspicion of 'red flags' e.g. spinal infection, malignancy, fracture, spinal inflammation, spinal cord compression (e.g. cervical myelopathy) or cauda equina syndrome. • Spinal trauma, instability (e.g. atlantoaxial instability), recent spinal fracture or spinal surgery within the last 2 years. • Brain or spinal cord injury or malformation. • Radiological evidence of moderate-to-severe central canal stenosis, lateral recess or foraminal stenosis, or a large disc protrusion accompanied by signs and symptoms of radiculopathy or neurogenic claudication. • Worsening upper or lower motor neuron deficits. • Radiculopathy accompanied by limb weakness e.g. foot drop. • Moderate-to-severe scoliosis with Cobb angle >20 degrees. • Peripheral entrapment neuropathies e.g. carpal tunnel syndrome. • High likelihood of need for surgical intervention. • Failed adequate trial of non-operative management for a potentially surgically amenable condition (e.g. spondylolisthesis with persistent symptoms). • Presence of a comorbid condition that also requires surgical assessment and management. • Referral from another hospital surgeon or physician to neurosurgery or orthopaedic spinal surgery. • Patients already well-known to neurosurgery, orthopaedics, rheumatology or chronic pain services. • Referrals for consideration of spinal surgical device implantation (e.g. spinal cord stimulators). • Patient and/or GP preference for patients to be assessed by a surgeon. • Patients referred for medicolegal opinions or compensable claims e.g. Transport Accident Commission (TAC), WorkSafe Victoria.

*Catchment area refers to the geographical area surrounding the hospital, from which patients are eligible to use its services.

Evaluation Framework, Study Outcomes and Data Collection

BAC was evaluated using the Victorian Innovation Reform Impact Assessment Framework (VIRIAF) (18), in line with Victorian DHHS requirements. Key areas of evaluation were: i) access to care; ii) appropriate and safe care; iii) workforce optimisation and integration; and iv) efficiency and sustainability. The four domains of the VIRIAF served as the primary study outcomes for the BAC pilot.

Quantitative data were obtained from auditing the centralised triage process and BAC activity from 22 July 2014 to 30 June 2015. Qualitative data were collected from surveys and interviews of patients (n=54), stakeholders (includes Neurosurgeons, Orthopaedic surgeons, Rheumatologists, hospital and community health managers and Physiotherapists) (n=14) and referrers (n=26) between 1 March 2015 and 30 June 2015 (*Table 2*~~*Table 2*~~). The BAC pilot evaluation was approved by the Melbourne Health Human Research Ethics Committee (QA2014148).

Table 2. Study outcomes as defined by the four domains of the Victorian Innovation Reform Impact Assessment Framework (VIRIAF) and the data sources and collection methods used.

VIRIAF Domains	Outcomes	Data Sources & Collection Methods*
Access to Care	• Patients receive timely access to expert management of low back and neck pain. • Patients receive convenient access to services within their local community. • Patients receive timely access to specialist surgical, rheumatology, chronic pain management and allied health services where indicated through newly developed and streamlined referral pathways of care.	• Clinic audit • Patient survey & interview • Referrer survey & interview • Stakeholder interview
Appropriate & safe care	• Patients with back or neck pain are directed to the most appropriate clinical service, including appropriate non-surgical management for those who either do not require or are unlikely to benefit from spinal surgery. • Patients redirected from neurosurgery, orthopaedic spinal, rheumatology and pain services experience no adverse outcomes. • Patients receive appropriate clinical services based on need and clinical evidence. • Patients experience continuity of care.	• Clinic and triage audit • Audit of hospital administrative data • Patient survey & interview • Referrer survey & interview • Stakeholder interview • Clinician survey & interview
Workforce optimisation & integration	• Service development and delivery involves multidisciplinary and cross-organisational collaboration, which also contributes to ongoing knowledge and skill development. • Surgeon time and skills are optimised	• Clinician survey & interview • Referrer survey & interview • Stakeholder interview

	towards assessing and managing patients with back or neck problems that are more likely to benefit from surgery and for conditions that are more time critical. • Advanced practice physiotherapist's and rheumatologist's skills are optimally used to assess and manage patients with back and neck pain. • The community health workforce capacity is expanded to include management of more complex patients with back and neck pain.	• Patient survey & interview
Efficiency & sustainability	• Cost-effective management of patients with low back or neck pain is demonstrated. • Service replicability and sustainability are demonstrated.	• Clinic and triage audit • Audit of hospital administrative data • Clinician survey & interview • Stakeholder interview • Use of MRIs and CTs

*Apart from the collection of patient surveys, which was conducted during the BAC pilot, all other data collection was performed at the conclusion of the 12-month pilot project.

Statistical Methods

Descriptive data were summarised using mean (SD) or median (IQR) for continuous variables and n (%) for categorical variables. Data on referral sources and waiting times were analysed for the whole cohort, while health services utilisation was analysed according to two subgroups: i) patients referred to and reviewed in BAC; and ii) patients referred to but not reviewed in BAC. Magnetic resonance imaging (MRI) costs were calculated using the Medicare Benefits Schedule (MBS) fee of $358.40 for spinal MRI (item numbers 63161, 63164, 63167, 63170, 63173, 63176, 63179, 63182, 63185), and the MRI utilisation rates in outpatient neurosurgery clinics for assessing spinal conditions was assumed to be 89.8% in line with published data (19). All analyses were performed using SPSS, version 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows. Armonk, NY, USA).

Patient and Public Involvement

A steering committee was formed to oversee the BAC pilot and included consumer representation. The consumer representative provided input on the research question, development of patient and referrer study information sheets, patient questionnaires used for data collection, and study evaluation. Results from the BAC pilot were made available to study participants that requested a copy of the research findings.

RESULTS

Study Population

Patient demographics are summarised in ***Table 3*** ~~***Table 3***~~. The majority (73.7%) of new referrals to RMH surgical clinics were deemed appropriate for BAC by the centralised triage team. In total, 522 in-catchment patients were referred to BAC (83.3% re-directed from

neurosurgery, 13.2% from orthopaedics), of whom 51.5% (n=272) were new referrals and 48.5% (n=250) were drawn from specialist clinic waiting lists. Most referrals were made by general practitioners (GPs) (87%) for LBP (63%) or neck pain (24%).

At the end of the pilot, 292 (55.9%) eligible patients had been reviewed in BAC (designated the BAC 'seen' group). Of the remaining 230 patients (designated the BAC 'not seen' group), 91 (17.4%) accepted but had not yet attended, 68 (13%) declined all services (the majority because their spinal symptoms had resolved), 61 (11.7%) were uncontactable, 2 (0.4%) had died and 5 (1%) had already attended an outpatient surgical appointment. Only 3 patients (0.6%) declined a BAC appointment. Of the 292 patients reviewed, complete data were available for 285 (97.6%) patients. Seven were excluded from the analysis due to incorrect or incomplete information. The mean (SD) age of patients seen (n=285) and referred but not seen in BAC (n=230) were 53.9 (16.8) and 53.6 (17) years respectively. The gender distribution in both groups was similar (47.7% and 43.9% males, respectively).

Table 3. Baseline characteristics of patients in the BAC 'seen' and 'not seen' groups.

Variable	'BAC seen' N=285	'BAC, not seen' N=230	Total N=515
Male: n (%)	136 (47.7)	101 (43.9)	237 (46.0)
Age in years at time of referral: mean (SD)	53.9 (16.8)	53.6 (17.0)	53.8 (16.9)
Catchment: n (%)			
Merri CHS*	161 (56.5)	151 (65.7)	312 (60.6)
cohealth	124 (43.5)	79 (34.3)	203 (39.4)
Referral source: n (%)			
General practitioner	250 (87.7)	204 (88.7)	454 (88.2)
Melbourne Health	35 (12.3)	25 (10.9)	60 (11.7)
Other public hospital	0 (0)	1 (0.4)	1 (0.2)
Clinic referred to: n (%)			
Neurosurgery	230 (80.7)	199 (86.5)	429 (83.3)
Orthopaedics	43 (15.1)	25 (10.9)	68 (13.2)
Rheumatology	4 (1.4)	4 (1.7)	8 (1.6)
Pain service	5 (1.8)	1 (0.4)	6 (1.2)
Back pain Assessment Clinic	3 (1.1)	1 (0.4)	4 (0.8)
Already on clinic waiting list, n (%)	121 (42.5)	129 (56.1)	250 (48.5)

Access to Care

For 194 newly referred patients reviewed in BAC, the mean (SD) time from referral to initial consultation was 9.8 (4.3) weeks, including referrals received 3 months prior to BAC's commencement. Of the 119 patients redirected from neurosurgery and orthopaedic outpatient waiting lists, the respective mean (SD) waiting times were 101.3 (42.4) and 70.5 (40.1) weeks (equating to a weighted-average of 100 weeks).

Of GPs who were aware of BAC (n=18), 61% felt BAC had improved access to care, and only two respondents indicated a preference for a surgeon to see their patients. Eight GPs (30.8%) indicated they were unaware of BAC, most likely because BAC was not advertised to GPs during the pilot. Surveyed patients (n=54) rated attending BAC at the community health centre as easier than travelling to RMH's acute hospital campus.

Appropriate and Safe Care

92.8% of patients in BAC were seen by the same clinician throughout their contact with the service, maintaining continuity of care. Following BAC consultation, 34% of patients had medications adjusted, 6% underwent a spinal injection (e.g. nerve root block), 57% were referred for community-based spinal rehabilitation and 6.1% were referred to another specialist service: 5 (1.8%) to Neurosurgery or Orthopaedics, 3 (1.1%) to Rheumatology, 9 (3.2%) to Chronic Pain Services. 53 patients (18.6%) were discharged after their initial BAC consultation. There were no patient complaints nor adverse incidents.

Analysis of available patient-reported outcomes (ODI/NDI, BPI-I/-S, GIS) showed improvements in all domains of disability, pain and overall well-being (***Table 4*** ~~***Table 4***~~). In terms of patient reported satisfaction, 94.4% of respondents recorded very high levels of satisfaction with the service, engagement with clinicians and clinicians' explanations. Similarly, 94.4% of respondents indicated they were 'very satisfied' (62.9%) or 'satisfied' (31.5%) with the service, 'very satisfied' (68.5%) or 'satisfied' (29.6%) with clinician care and either 'strongly agreed' (66.7%) or 'agreed' (27.8%) that their expectations had been met. Surveyed GPs (n=26) expressed satisfaction with the communication received from BAC ('strongly agreed' 15.4%, 'agreed' 42.3%).

Table 4. Changes in patient-reported outcomes among BAC patients.

Outcome measure	n	Mean (SD)	95% confidence interval*
Oswestry or Neck disability index (%): change from first visit to latest visit[#]	33	-7.8 (11.5)	-11.7 to -3.8
Brief Pain Inventory - Severity: change from first visit to last visit[#]	18	-2.1 (2.3)	-1.0 to -3.1
Brief Pain Inventory - Interference: change from first visit to last visit[#]	20	-1.8 (2.5)	-0.7 to -2.9
Global Improvement Scale: maximum category at any subsequent visit	53	5.0 (1.3)	4.6 to 5.3

Mean ± 1.96[SD/√n]

[#]negative value indicates improvement

Workforce Optimisation and Integration

Surveys of stakeholders suggested that BAC promoted more efficient use of surgeons' skills and time. Stakeholders and GPs (61.5%) regarded involving a Rheumatologist in BAC was important for ensuring medical issues were identified and appropriately managed. Stakeholder feedback regarding the role of APP was also positive, although less than 40% of GPs felt they understood their role.

Efficiency and Sustainability

The clinician costs of staffing BAC and traditional Neurosurgery/Orthopaedic clinics are summarised in ~~Table 5~~Table 5. To review 15 patients in a 3.5-hour session, BAC costs $68.60 per patient, compared to $44.80 per patient seen in a surgical clinic, meaning a cost-differential of $23.80 per patient. However, BAC was associated with substantial cost savings through reduced MRI usage. Among the 285 patients seen in BAC, 97 (34%) had already undergone MRI scanning prior to BAC attendance, while a further 18 patients (6.3%) were referred for an MRI after BAC assessment. Compared to standard practice in existing surgical clinics, BAC reduced the proportion of patients having MRI scans from an assumed 89.8% (19) to 40.3% (absolute difference 49.5%), conferring a cost-saving of $180 per patient, or total cost-saving of $52,560 during the pilot.

Table 5. Comparison of clinician costs of staffing BAC and traditional surgical clinics.

	BAC	Neurosurgical/Orthopaedic clinic
Consultants	1 @ $135/hour (HN29, mid-tier)	1 @ $135/hour (HN29, mid-tier)
Registrars	1 @ $57/hour (HM29, upper tier)	1 @ $57/hour (HM29, upper tier)
Advanced practice physiotherapist x 2	$51/hour (VC8, upper tier)	N/A
Number of patients seen per session (3.5 hours)	15	15
Cost per patient seen	$68.60	$44.80
Total staff costs for 3.5 hour session	$1029	$672

DISCUSSION

Evaluation of the BAC pilot demonstrates it is a potentially safe and effective model for managing referrals to hospital services for neck and LBP. BAC is a collaborative initiative that integrates tertiary hospital stakeholders and community health services to deliver more coordinated and efficient care. This was made possible through (i) establishing the BAC clinical pathway that provides patients with streamlined access to community- and hospital-based expertise, (ii) DHHS funding, and (iii) unprecedented cooperation and good will from stakeholders. BAC helped transform typically fragmented and variable care of LBP in current service models and was associated with high levels of patient reported satisfaction.

Establishing BAC as a community- and catchment-based service provided convenient access to tertiary care expertise and improved communication and coordination of care between tertiary and primary care clinicians. This was favourably regarded by stakeholders. The

process to establish stakeholder consensus criteria for referral to BAC encouraged confidence that patients were triaged to the most appropriate service and care was not compromised. This was supported by the finding that most referrals (73.7%) were deemed appropriate for BAC and following assessment in BAC, only 1.8% required surgical review. Moreover, there were no adverse patient outcomes. The centralised triage process also provided a single entry point for all referrals for neck and LBP. This allowed the service to 1) 'sort' referrals and triage them to the most appropriate service, 2) consolidate duplicate referrals made to multiple specialties for a single patient, 3) calibrate clinicians from different disciplines in triaging referrals, 4) apply and refine the BAC consensus criteria and 5) regularly hold multidisciplinary case conferencing and share expertise.

BAC was associated with substantially lower MRI utilisation compared to surgical clinics. This translated to a saving of $52,560 during the pilot and a substantial opportunity cost of improved MRI access for other patients. Beyond savings in MRI costs, BAC improved patient access to evidence-based care (e.g. patients received care 90 weeks or 1.7 years earlier) and promoted more effective deployment of surgeons' skill and time. Finally, Rheumatology involvement provided the APPs and registrar with specialist support for patient assessment (e.g. requesting and interpreting investigations) and optimising non-surgical management (e.g. analgesia review, performing diagnostic/therapeutic joint injections, referral for spinal nerve blocks). This was favourably regarded by referrers and stakeholders.

There are few studies of models of care for neck and LBP and none have been comprehensively evaluated (11, 12, 20, 21). Preliminary evidence from APP-led triage services from Australia (21), the U.S. (20) and Canada (11, 12) demonstrate similar trends in improved patient satisfaction, referral practices, reduced waiting times, cost and potentially improved patient outcomes. The BAC model differed in several respects. First, BAC is likely to have less risk of missing 'red flags' given these referrals are excluded from BAC (Table 1) and are carefully screened for using a standardised pro forma during BAC consultation. Second, the centralised triage process is unique to BAC and facilitated standardisation of clinician triage practices. After completion of the pilot, centralised triage was performed by the BAC rheumatologist and APPs. Third, the BAC clinical pathways provided patients with streamlined access to community- and hospital-based services. Fourth, BAC provided more holistic and efficient patient care through involvement of a Rheumatologist to ensure that evidence-based management was adequately trialled and appropriate investigations were organised prior to surgical review. Finally, BAC is one of the first tertiary neck and LBP services to have been established in primary care.

Our study findings are subject to the limitations of an observational study design. Interpretation of the evaluation is restricted by the modest sample size of patient and GP responses, limited economic analysis (including omission of the central triage process staffing costs), absence of long-term follow-up and our study lacked a historical comparator group. We were also unable to track the progress of patients who had been directly triaged to attend specialist consultation rather than BAC, which if known, may have provided a more complete picture of the effect of the BAC model, particularly the central triage process. The BAC model therefore warrants further validation using a rigorous comparative analysis to routine care, ideally in the form a randomised clinical trial. At the time of manuscript

submission, the Victorian DHHS has funded replication of the BAC model in three other Victorian hospitals. Evaluation of BAC's implementation at other sites will help further validate findings from the pilot study.

CONCLUSION

The BAC model is a novel care pathway that provides patients with neck and LBP with streamlined access to community-based expert assessment and spinal rehabilitation, as well as hospital-based specialist expertise. The results of this pilot study suggest that BAC is a potentially safe and cost-saving alternative model of care, associated with substantial reductions in MRI usage compared with traditional surgical clinics. The initial findings from the BAC pilot merit further evaluation to determine the cost-effectiveness, longer-term and broader societal impact of implementing BAC more widely.

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Figure 1. Traditional/existing service model in most Australian hospitals for managing outpatient referrals for specialist care of low back and neck pain.

Figure 2. Health service redesign for managing low back and neck pain referrals implemented during the BAC pilot.

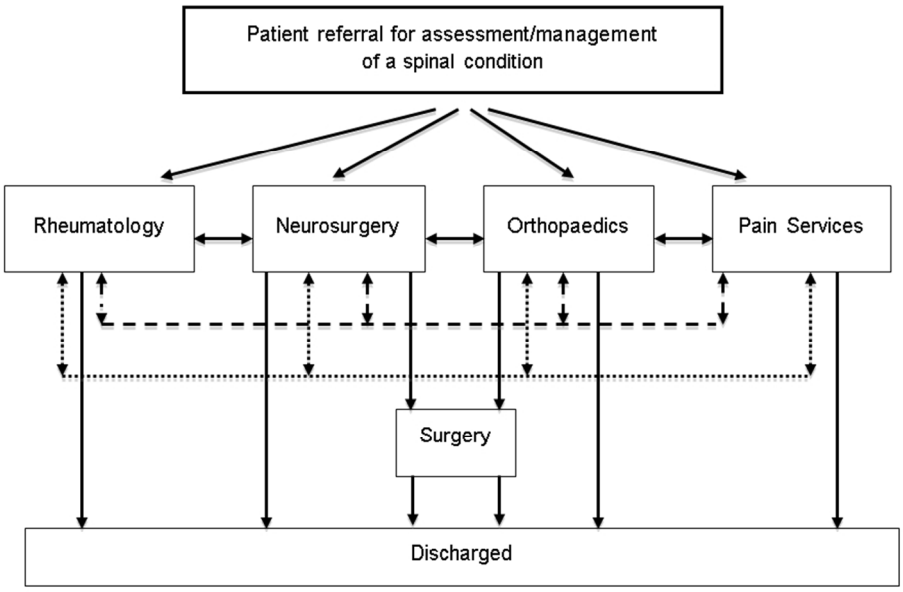

Figure 1. Traditional/existing service model in most Australian hospitals for managing outpatient referrals for specialist care of low back and neck pain

342x228mm (72 x 72 DPI)

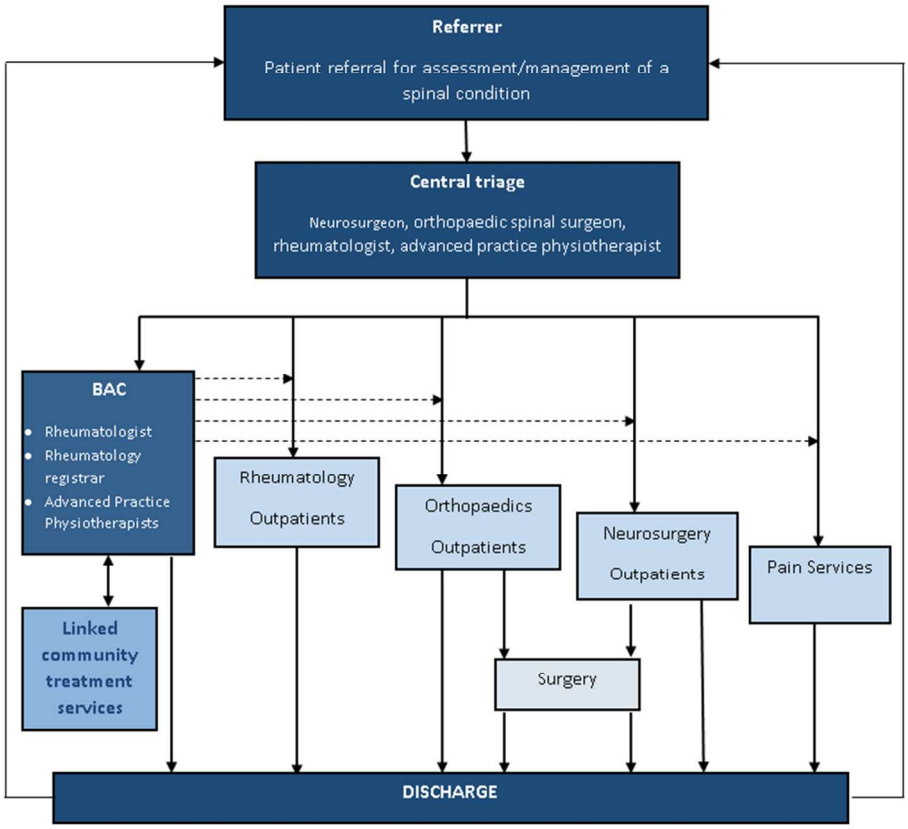

Figure 2. Health service redesign for managing low back and neck pain referrals implemented during the BAC pilot

284x256mm (72 x 72 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract **[PAGES 1, 3]**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **[PAGE 3]**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **[PAGE 5]**
Objectives	3	State specific objectives, including any prespecified hypotheses **[PAGE 5]**
Methods		
Study design	4	Present key elements of study design early in the paper **[PAGES 5-11]**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **[PAGES 5-11]**
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up **[PAGES 6-9]** *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed **[N/A]** *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **[PAGES 9-10]**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **[PAGES 9-10]**
Bias	9	Describe any efforts to address potential sources of bias **[PAGE 15]**
Study size	10	Explain how the study size was arrived at **[PAGE 11]**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why **[PAGE 11]**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **[PAGE 11]**
		(*b*) Describe any methods used to examine subgroups and interactions **[N/A]**
		(*c*) Explain how missing data were addressed **[PAGE 11]**
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed **[N/A]** *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses **[N/A]**

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **[PAGE 11]**
		(b) Give reasons for non-participation at each stage **[PAGE 11]**
		(c) Consider use of a flow diagram **[N/A]**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **[PAGES 11-12]**
		(b) Indicate number of participants with missing data for each variable of interest **[PAGE 11]**
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) **[PAGE 6]**
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time **[PAGES 12-14]**
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **[PAGES 12-14]**
		(*b*) Report category boundaries when continuous variables were categorized **[PAGES 12-14]**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **[N/A]**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **[N/A]**
Discussion		
Key results	18	Summarise key results with reference to study objectives **[PAGES 3, 14-15]**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **[PAGE 15]**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **[PAGES 14-15]**
Generalisability	21	Discuss the generalisability (external validity) of the study results **[PAGES 14-15]**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **[PAGE 6]**

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.