Deloitte Access Economics

Osteoarthritis Chronic Care Program evaluation

Agency for Clinical Innovation

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Deloitte.

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Glossary

6MWT	6 Minute Walk Test
ACI	Agency for Clinical Innovation
ADL	Functionality in Daily Living
AIHW	Australian Institute for Health and Welfare
GP	General Practitioner
NH	Nepean Hospital (Nepean/Blue Mountains)
HOOS	Hip Oxford Outcomes Score
RNC	Royal Newcastle Centre
KOOS	Knee Oxford Outcomes Score
LGA	Local Government Area
OA	Osteoarthritis
OACCP	Osteoarthritis Chronic Care Program
PMBH	Port Macquarie Base Hospital (Port Macquarie)
RNSH	Royal North Shore Hospital (Royal North Shore/Ryde)
BH	Bowral Hospital (Bowral)
FH	Fairfield Hospital (Fairfield)
GH	Gosford Hospital (Gosford/Wyong)
SH	Sutherland Hospital (Sutherland/St George)
TUG	Timed Up and Go
TWH	Wollongong Hospital (Wollongong)

Executive Summary

Deloitte Access Economics was engaged by the Agency for Clinical Innovation (ACI) to undertake an evaluation of the Osteoarthritis Chronic Care Program (OACCP). The evaluation comprised two components:

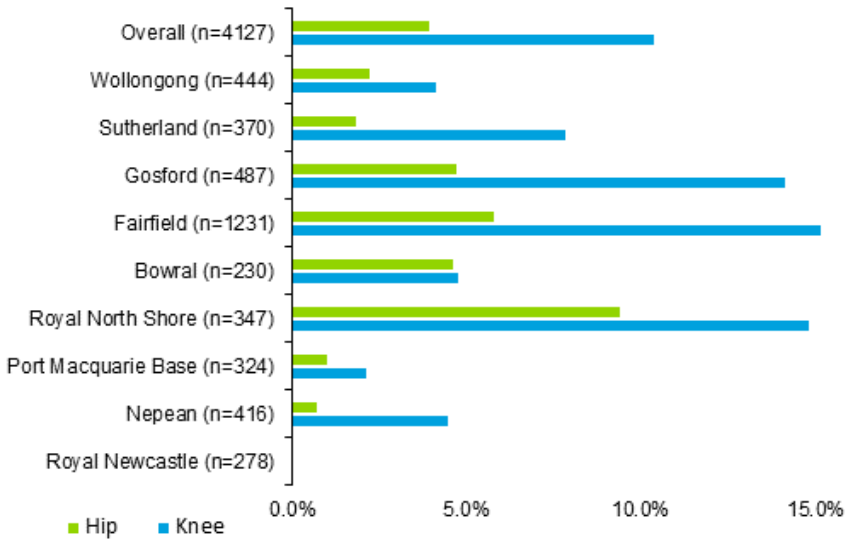
- **phase 1:** assessment of the implementation of the OACCP across the pilot sites to determine the factors enabling or hindering the implementation and effective delivery of the program through consultations with OACCP sites; and
- **phase 2:** analysis of the short and intermediate outcomes of the program for patients and the health system by drawing on data from the OACCP database and admitted patient data for NSW hospitals.

The process evaluation was qualitative in nature and involved semi-structured phone and face-to-face interviews with staff across all the OACCP pilot sites. The outcomes evaluation, on the other hand, was quantitative in nature, and drew on data from a range of sources to measure whether the OACCP has achieved its intended outcomes.

Overall, the analysis shows that the OACCP has been effective in improving clinical outcomes such as pain, mobility, and functionality for patients with osteoarthritis of the knee, while the impact on patients with osteoarthritis of the hip is less clear. In addition, it was estimated that the introduction of the OACCP was correlated with a slight reduction in obesity and hypertension for patients at program sites, suggesting that the program is a valuable component of a broader chronic disease management strategy.

The relatively stronger clinical outcomes for participants with osteoarthritis of the knee is reflected in relatively more program participants waiting for a knee replacement being removed from surgical waitlists because they no longer require surgery: the analysis shows that around 11% of knee osteoarthritis patients and 4% of hip osteoarthritis patients who were removed from surgical waitlists across program sites no longer require surgery.

Chart i: Share of OACCP waitlist removals that no longer require surgery



Across the pilot sites, Nepean/Blue Mountains, Port Macquarie, Fairfield and Wollongong tended to have patients with lower than average initial Hip disability and Osteoarthritis Outcome Score (HOOS) and Knee injury and Osteoarthritis Outcome Score (KOOS) scores, as well as a lower proportion of knee osteoarthritis patients compared to hips. Patients at these sites also tended to have worse than average initial TUG and 6MWT scores as well as a higher number of comorbidities (more than three on average). Royal North Shore, Bowral and Newcastle had healthier than average patient cohorts enrolled in their program. Keeping these differences in mind, Royal North Shore still performed relatively well across a number of outcomes. Port Macquarie and Gosford also reported positive pain and mobility outcomes despite Port Macquarie having more complex patients.

At a system level, the implementation of OACCP program did not have a significant impact on reducing the length of stay of knee or hip replacement separations. However, a number of enhancements could be made to this analysis in the future in order to be able to estimate a more accurate impact of the OACCP on patient length of stay, and therefore more accurately estimate the impact of the OACCP on the efficient use of resources in the health system.

The consultations with pilot sites suggested that the biggest factor that contributed to the successful implementation of the OACCP is strong buy-in from all relevant stakeholders including the executives, allied health department heads and orthopaedic surgeons. Royal North Shore in particular appeared to have a strong advocate of the program within the hospital and, as a result, appeared to have a cohesive team that worked well together in achieving outcomes for participants.

An overwhelming majority of those consulted noted the opportunity for the OACCP to target patients much earlier in their OA pathway before they see an orthopaedic surgeon. Some went as far to say that the program should be more community-based and take on a more primary prevention focus, rather than targeting patients who are already on the surgical waitlist. This would ensure that patients are provided with the option of conservative OA management early on, leading to potentially better patient outcomes. From the ACI and the program's perspective, earlier intervention may also mean better value-add for patient outcomes.

Deloitte Access Economics

1 Introduction

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- **phase 1:** assessment of the implementation of the OACCP across the pilot sites to determine the factors enabling or hindering the implementation and effective delivery of the program through consultations with OACCP sites; and
- **phase 2:** analysis of the short and intermediate outcomes of the program on patients and the health system by drawing on data from the OACCP database and admitted patient data for NSW hospitals.

1.1 Osteoarthritis and its management

Osteoarthritis (OA) is a degenerative joint disease associated with the breakdown of cartilage, which acts as a cushion where bones come together. Cartilage can start to breakdown with age and joint use, thus reducing the protective cushion between the body's bones. In osteoarthritis, this process causes the bone underneath the cartilage to thicken and broaden out. If the disease worsens, cartilage may break away from the bones, causing the bones to scrape against one another and become bruised or damaged.

The main symptoms of osteoarthritis are joint pain and stiffness. The disease can limit joint movement and flexibility, and in extreme cases it can cause severe disability and affect a person's ability to do normal daily activities such as walking and using their hands. Furthermore, a 2008 report by the AIHW noted that the disease can also have negative social impacts – it can affect an individual's ability to be independent, their social life, relationships and emotional wellbeing (AIHW 2008). In terms of emotional wellbeing, this report observed that limitations imposed by osteoarthritis can be detrimental to a person's self-esteem and self-image and can lead to negative emotional states, anxiety, depression and feelings of helplessness (AIHW 2011; Sheehy 2006).

In 2007, an estimated 3.85 million Australians had arthritis, and 17% of this group had osteoarthritis (AIHW 2011). In people 65 years of age and older the risk of disability due to knee OA is greater than disability due to any other medical condition (ACI 2012). Osteoarthritis accounted for 0.6% of all disability adjusted life years (DALYs) lost and 10.0% of DALYS lost due to musculoskeletal conditions. This burden accounted for 2.2% of global years of life lost due to disability (YLD) and 10% of all YLD from musculoskeletal disorders, with 50048.3 DALYs being lost in 2010 alone (GBD 2010).

The two primary risk factors for osteoarthritis are age and excess body weight. Given Australia's ageing population and the increase in the prevalence of obesity, the prevalence of OA is expected to increase. An Access Economics report estimated that between 2007 and 2020, the number of people with OA in Australia will double (Access Economics for Arthritis Australia 2007).

1.1.1 Guidelines and best practice in osteoarthritis care

There is a wealth of evidence based literature outlining best-practice principles for the management of osteoarthritis, but despite a clear consensus in the literature there is a significant divergence between OA care as it is implemented in NSW and any of the best-practice models of care that have been developed with reference to the currently available evidence.

The model of care implemented by the OACCP is a multi-disciplinary management program for OA of the hip and knee, and is aimed at improving pain, function and ultimately quality of life for the patient. This program, through the improvement in the health literacy and self-care capability of the patient, also plays a role in preventing unnecessary, ineffective or harmful interventions. Although models of care may differ in their specific implementation, there is significant consensus around the general principles that drive best-practice care.

The primary goals of management of OA of the hip and knee are:

- symptom control to reduce pain and stiffness;
- limitation of disease progression;
- optimisation and maintenance of function;
- optimisation and maintenance of quality of life;
- effective use of health care services.

Best-practice guidelines for the treatment of OA focus on conservative management of the disease. The principles of conservative OA management are:

- **Self-management.** This principle focuses on self-monitoring and managing their own health as much as possible. This includes individual health parameters, engagement in health activities and encouragement to be an active partner in their medical and surgical health care decisions (RACGP 2009, Fernandes et al 2014,).
- **Disease Management.** An important element of self-management is understanding OA more deeply, including an understanding of the disease process and the evidenced-based management of Osteoarthritis (ACI 2012). Disease management focuses on highlighting the importance of following management plans, and outlines the specific lifestyle behaviour necessary to facilitate improvement in quality of life or to slow disease progression (ACI 2012).
- **Exercise.** Improving muscle strength to support damaged joints is an important element of OA treatment. The literature suggests that supervised group or individual treatments are superior to independent home exercise in achieving reductions in pain, while all modes of delivery produce similar results for physical function (ACI 2012).
- **Weight Loss**. The literature suggests that physical ability improves in obese and overweight people with knee OA after moderate weight reduction (Christensen et al 2007). A combination of changes to diet and the individual's level of exercise may significantly improve their function and/or pain.
- **Psychological management.** As previously mentioned, people with OA often experience psychological problems associated with their physical limitations and subsequent impacts on their independence and social lives. The literature suggests that up to 50% of people with OA suffer from depression (Lin et al 2003).

- **Pharmacologic management.** Inappropriate poly-pharmacy is often experienced by people with OA, due to the high incidence of comorbidities within this group (ACI 2012). Common issues include poorly controlled hypertension on NSAIDs or constipation associated with opiates. Pharmacologic management can ensure that these negative interactions are avoided or rectified.

The OACCP program, which is outlined in more detail in section 1.1.2, incorporates each of these elements. The program provides non-surgical treatment options to people experiencing OA (such as physio therapy, dietary advice, podiatry advice, support for mental health problems etc.) in order to reduce symptoms and improve quality of life. The program also functions to improve waitlist management for necessary knee and hip replacements, by monitoring the symptoms of patients over time and providing information to surgeons on the urgency of a required surgical intervention.

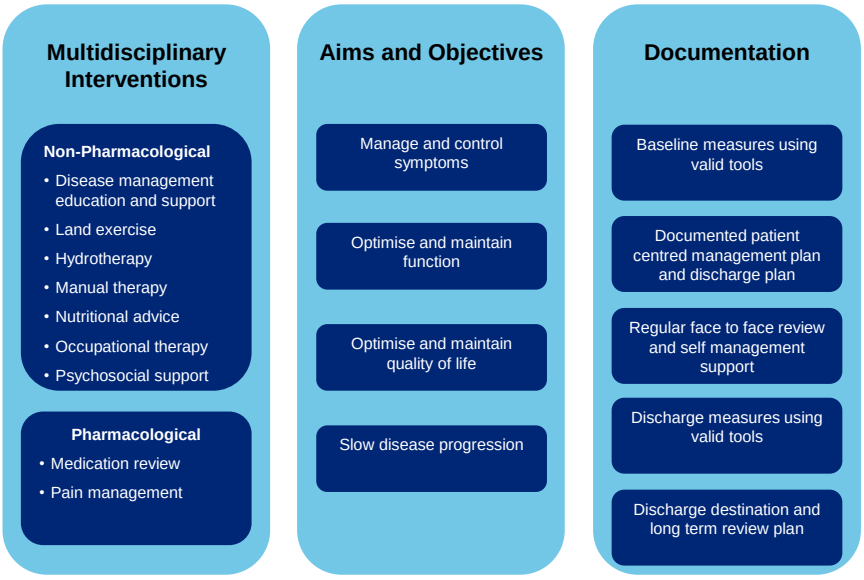
1.1.2 Clinical practice

As mentioned in the previous section, clinical practice often does not reflect the clear evidence based consensus around best-practice treatment of OA. Treatment is often limited to prescription medicines and waiting for an eventual total joint replacement (Hunter 2011). Despite consistency across recommendations (Royal Australian College of General Practitioners 2010; Zhang et al 2005, 2008), the evidence suggests that clinical practice does not reflect these guidelines (Glazier 1998; Jawad 2005; DeHaan 2007). The ACI (2012) report suggests that barriers to implementation of recommended guidelines could be due to the complexity of the guideline documents (despite the guidelines themselves being simple), clinician factors such as beliefs and attitudes, system factors that inhibit access to the recommendations at the point of care, or individual factors which hinder uptake, adoption and maintenance of new behaviours.

1.2 Osteoarthritis Chronic Care Program

The OACCP is a comprehensive, multidisciplinary management program for OA of the hip and/or knee (ACI 2012). The OACCP was implemented at different times across the pilot sites, with both the Fairfield and Nepean/Blue Mountains hospitals beginning their programs in late 2010. The program targets improvements in pain, function and quality of life. The ACI has set out an 'ideal OACCP participant journey', which included the elements summarised in Figure 1.1.

Figure 1.1: Osteoarthritis management plan



In the OACCP program, teams are led by a dedicated Musculoskeletal (MSk) Coordinator. The coordinator at funded sites is typically a physiotherapist with extensive experience in the care of people with musculoskeletal problems. The role of the coordinator is to lead and coordinate the development, implementation and ongoing evaluation of the OACCP. OACCP teams draw from a broad range of medical, nursing and allied health expertise as required by patients. These professionals can include:

- GPs;
- Specialist doctors;
- Physiotherapists;
- Nurses;
- Occupational Therapists;
- Dietitians;
- Psychologists;
- Social Workers;
- Pharmacists;
- Exercise Physiologists; and
- Podiatrists; and
- Others as required.

The goal of OACCP teams is to provide the most appropriate care in the most appropriate place for each individual to help them to self-manage their OA with conservative treatments.

1.2.2 OACCP implementation

The OACCP program was implemented at seven Local Health Districts funded by a one-off grant from the NSW Ministry of Health. This funding, plus a self-funded site, accounted for fully operational OACCPs at fourteen sites in NSW. From these fourteen sites, nine different

programs have been reported with some sites having fully integrated with another site. [1] This grant was intended to incorporate costs associated with the set up and piloting of the OACCP, and enable sites to provide a multidisciplinary team with clinical support and an appropriate medical officer to mentor the team as required.

Table 1.1: First participant recorded at each pilot site

Site	Date of First Participant Recorded	Program still in operation?
Royal Newcastle	24/02/2011	Yes*
Nepean	23/09/2010	Yes
Port Macquarie	3/05/2011	Yes
Royal North Shore	15/06/2011	Yes
Bowral	17/10/2011	No
Fairfield	13/11/2009	Yes
Gosford	17/02/2011	Yes
Sutherland	5/07/2011	Yes*
Wollongong	4/07/2011	No

*Sutherland hospital has reduced the scale of its program (staff and patients) due to level of funding and resources, and Royal Newcastle has indicated that it will be continuing but in a community based setting. Royal North Shore was not funded by the one-off grant.
Source: OACCP Database.

The objective of the OACCP is to improve the coordination of care for people with osteoarthritis and to manage the care of these patients through a conservative care management pathway. For the current implementation of the program, the majority of participants have been referred from the joint replacement surgery waitlist (as directed by the NSW Ministry of Health), which would suggest that most of these patients will ultimately require joint replacement surgery. The primary aim of the program is to reduce pain, increase functional capacity and ultimately improve quality of life for the participants before they receive surgery. Going forward, the program could be expanded to include patients who are not yet on joint replacement surgery waitlists, and may therefore provide a conservative management pathway as an alternative to joint replacement surgery.

The goal is for OA patients to receive the optimal treatment, regardless of the need for surgery, and for the capability and capacity to be developed to escalate people on the waitlist based on their clinical needs. Additionally, the active management of individuals who have OA and have already been referred for surgery is hoped to facilitate the removal from, or escalation on, the surgical waitlist where appropriate - this includes the treatment of co-morbidities that may be present, through addressing risk-factors related to weight, physical activity and diet, although important in its own right.

[1] The fourteen sites are Royal Newcastle Centre, Port Macquarie, Camden Haven, Kempsey (these last two are entered into the PM data), Fairfield, Bowral, Sutherland, St George (St George data entered into the Sutherland data), RNSH, Wollongong, Nepean, Blue Mountains (BM data entered into the Nepean data), Gosford and Wyong (Wyong data entered with Gosford data).

1.2.3 OACCP participants

Table 1.2 provides an overall summary of the characteristics of OACCP participants across all the pilot sites. Across all sites, the majority of patients referred to the program have osteoarthritis of the knee.

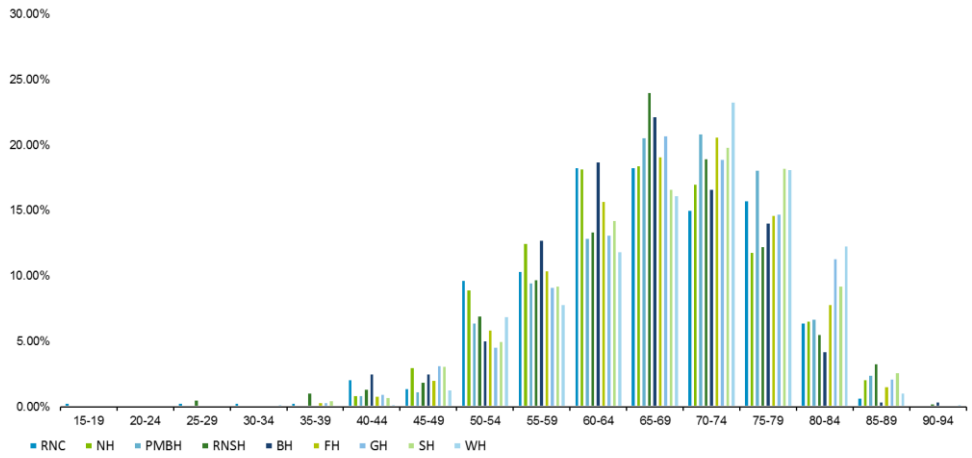
Table 1.2: Characteristics of current OACCP participants (2011-12 to 2013-14)

	RNC	NH	PMBH	RNSH	BH	FH	GH	SH	WH	Total
% females	57.6%	64.8%	59.2%	67.8%	52.8%	61.4%	59.9%	61.3%	56.0%	60.9%
% knee patients[1]	65.8%	68.6%	69.2%	81.7%	61.7%	72.3%	70.0%	74.2%	69.9%	71.7%
% hip patients[1]	23.9%	31.2%	30.3%	17.2%	37.4%	27.4%	28.7%	24.8%	30.1%	27.1%
Average initial HOOS	36.8	32.2	33.0	43.2	36.0	29.9	34.5	33.8	34.2	33.9
Average initial KOOS	42.3	39.3	40.7	48.9	43.0	36.7	43.2	43.6	40.6	41.4
Average initial TUG	12.3	15.5	11.8	11.1	13.2	17.5	11.8	13.8	15.3	14.3
Average initial 6MWT	338.5	307.9	331.2	415.4	359.0	287.7	340.6	306.3	304.9	327.1
Average number of comorbidities	3.3	2.3	3.9	2.2	2.7	2.4	2.8	2.6	3.6	2.8
% of participants completed 80% of their Care Plans	3.0%	0.8%	49.9%	42.3%	24.7%	34.7%	31.2%	50.8%	60.4%	35.3%

Source: OACCP Database.
[1] Patients are classified as hip, knee or hip and knee.
Note: Variations across sites may be due to data collection issues rather than performance.

Chart 1.1 summarises the age distribution of patients who have participated, or are participating, in the OACCP. As expected, the large majority of patients are between 60 and 79 years.

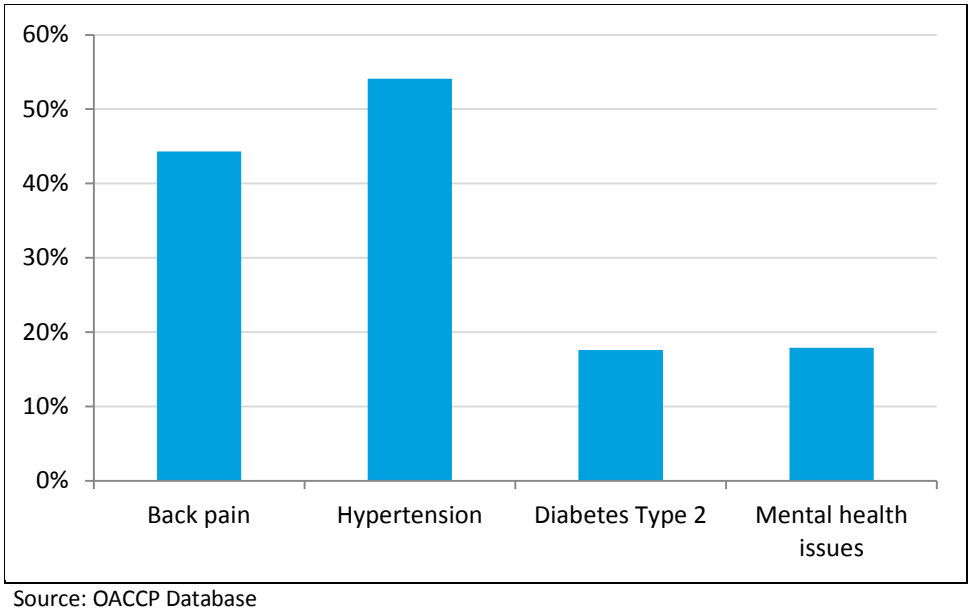
Chart 1.1: Age distribution of patients in OACCP by site (2011-12 to 2013-14, % of participants)



Source: OACCP Database.

Chart 1.2 summarises the most common comorbidities patients presented into the program with at their initial assessment. Of those in the program, over 60% of patients had hypertension, followed by over 49% with back pain. Nearly 20% of patients had type two diabetes mellitus and/or mental health issues. On average across all sites, patients had two to three comorbidities.

Chart 1.2: Most common patient comorbidities (2011-12 to 2013-14)



Source: OACCP Database

1.3 Objective of the process evaluation

> The aim of the process evaluation is to examine the OACCP's implementation against its objectives, the reach and access of the program, and the key enablers and barriers to the implementation and the effective operation of the program.

The process evaluation aims to shed light on the following subset of questions:

- What were the key processes used to implement the program at the nominated pilot sites?
  - What are the key enablers and barriers to the implementation and the effective operation of the program?
  - How could the program be improved?
- How was the implementation structured at each site and how was it resourced?
  - What level of resourcing was required at each site, and how is the current level of resourcing structured?
  - Were any additional training provided for staff at implementation, or are there any areas of training deemed valuable?
  - How well do staff of the hospital outside of the OACCP team understand the program?
- How many participants are treated at each site?
  - What is the current eligibility criteria and referral process, and does this need to be adjusted?
  - What are the complexities patients generally present with?

1.4 Objective of the outcomes evaluation

> The aim of the outcomes evaluation is to examine the impact of the program on short and intermediate term patient outcomes.

The outcomes evaluation aims to shed light on the following subset of questions:

- What outcomes have been achieved for the patients, service providers, and the health care system?
- Are program outcomes sustainable and adaptable to further sites?
- Has the OACCP provided equity of access to patients with osteoarthritis?

1.5 Program logic framework

The program logic framework for the OACCP was developed by ACI and the Musculoskeletal Network. The purpose of the logic framework is to:

- assist in clarifying program intent;

- build a common understanding amongst stakeholders of how the program works and the key objectives and outcomes to be achieved; and
- identify the key areas of focus for the evaluation.

The logic framework provides a useful reference for the process and outcomes evaluations. In particular, it is useful for identifying the agreed objectives, outcomes, outputs and inputs of the OACCP to be considered in the evaluation. These have informed the scope of issues to be considered in relation to the evaluation questions. A full copy of the logic framework can be found at Appendix A.

2 Methodology

2.1 Data sources

The data sources used for the process and outcomes evaluation are described in Table 2.1.

Table 2.1: Data sources used

Data Source	Description	Used to Measure
Hospital Activity Data	This data-set gives demographic and outcome data on each separation that is associated with osteoarthritis.	Length of stay, comorbidities, procedures
OACCP Database	This data-set was collected by the OACCP program directly, and gives outcome data for each patient over time, as well as demographic data for each patient.	Pain, Quality of Life, Mobility, Depression, Anxiety and Stress
Site consultations	These data are were gathered from the site consultations that were primarily undertaken for the process analysis, but also provided insights for the outcome analysis	Waitlist management, Provide context to other outcome measures

In the OACCP database, sites not included in the Model of Care as pilot sites or were no longer operational in 2011 including Coffs Harbour, Dubbo and Grafton were excluded from the analysis. As sites implemented the OACCP at varying times, 2011-12 was used as the commencement period as it provided the first full year of data. Data for 2013-14 was also included in the analysis, though it should be noted that this does not include data for June 2014, and some sites are no longer operating in 2013-14.

Details of the data used can be found in Appendix C.

2.2 Process evaluation

The process evaluation was qualitative in nature and involved semi-structured phone and face-to-face interviews with staff across all the OACCP pilot sites. 0 details the site and methods of consultation across the sites. The roles of those participating included an orthopaedic surgeon, Local Health District executive director, facility general manager, a Local Health District clinical innovation support officer, coordinators of OACCP and the various multidisciplinary team members.

Table 2.2: Semi-structured interviews with OACCP team members

Pilot site	Method
Royal North Shore/Ryde	Face-to-face
Wollongong	Tele-conference
Nepean	Tele-conference

Pilot site	Method
Royal Newcastle	Tele-conference
Bowral	Tele-conference
Fairfield	Tele-conference
Gosford	Tele-conference
Newcastle	Tele-conference
Port Macquarie	Tele-conference
Sutherland	Face-to-face

A set of questions for the semi-structured interviews were developed to guide the discussions with stakeholders, and can be found in Appendix A. The questions are mapped against the key evaluation questions as per the OACCP Evaluation Plan.

While a number of consultations were conducted to ensure all those involved directly or indirectly with the program were engaged, there was a significant degree of 'data saturation' among OACCP team members. The orthopaedic surgeon and the Clinical Innovation Support Officer (an anaethestist) provided a different perspective and some additional insights.

2.2.2 Caveats and limitations of approach

The focus of the process evaluation is to assess the implementation of the OACCP across the pilot sites. While there were some common perceptions of the program, it should be noted that, given the nature of the program where program teams are comprised of a small number of staff, the feedback necessarily reflects the views of a handful of people. In addition, the distribution of the stakeholders consulted did not represent all relevant stakeholders of the program; it would have been beneficial to consult with:

- more orthopaedic surgeons to gauge their views of the program, whether they supported the program, and if they did not support the program, what are the key reasons. This is particularly important given the importance of surgeon buy-in was emphasised in the consultations;
- allied health department heads who were either supportive or not involved in the program to obtain their view on the program and how they felt the program could work better in developing a more coordinated and integrated approach to OA. Three managers were interviewed, but more involvement would have been valuable; and
- other chronic care program coordinators to gauge their views on how the OACCP could be better integrated and coordinated with their chronic care program to ensure continuity and consistency in patient care.

Another key limitation to the approach is the large variation in the program implementation across the sites. Some sites already had a program similar to the OACCP prior to implementation; the program is still operating in some sites and not in others; and the level of funding and structure of the program in each site varies significantly. Hence, it is important to note that while some key themes works for some sites, it may not necessarily work for all sites as it will also depend on the typical patient cohort at each site (e.g. Culturally and Linguistically Diverse) and the structure of the program.

2.3 Outcomes evaluation

The outcomes evaluation was quantitative in nature, and involved using data drawn from a range of sources to measure whether the implementation of the OACCP at program sites resulted in the intended outcomes of the program.

The outcomes evaluation was undertaken to address the program evaluation questions relating to program outcomes. Table 2.3 lists the evaluation questions answered in the outcomes evaluation.

Table 2.3: Indicators used to address evaluation questions

Evaluation Question	Indicators Used
What outcomes have been achieved for the participants, service providers, and the healthcare system?	• Average change in patient length of stay at program sites • % of patients that have improved their mobility over the duration of the program • % of patients that have reduced their pain over the duration of the program • % of patients that have been able to leave the waitlist after attending the program
What unexpected outcomes occurred throughout the program either adverse or positive?	• Change in the number of co-morbidities
Did the performance indicators relate to the program and quality improvement?	• Enablers and barriers emerged from the consultations for the process evaluation – did the sites that had these enablers and a minimal number of barriers perform better in the indicators above?

2.3.2 Change in average patient length of stay at program sites

Average patient length of stay is a useful indicator as it measures a real impact of the introduction of the OACCP program that simultaneously impacts on patients, service providers, and the health system as a whole.

The impact of the implementation of the OACCP on the average patient length of stay was measured by (1) observing how the average length of stay changed at OACCP program sites and non-OACCP hospitals following the implementation of the OACCP at each program site, and (2) by subtracting the change in average length of stay observed at non-OACCP hospitals from the change in average length of stay observed at OACCP hospitals; this calculation identifies the change in the average length of stay that was due only to the implementation of the OACCP, and is known as a '**Difference-in-Differences**' estimate.

The intuition behind the analysis is to use the hospitals that did not implement the OACCP as the baseline case for the OACCP program sites, after standardising for the age and gender composition of the patients. The differences between the OACCP sites and the non-OACCP sites that occur after the implementation of the OACCP are estimated as a measure

of the impact of the program. As this analysis uses both the state of the hospital before the program was implemented and the outcomes in the non-OACCP sites as a baseline, it is able to control for many variables that may be difficult to control for or account for directly.

Model description

The Difference-in-Differences estimate was obtained by estimating the following econometric regression model:[2]

$$Outcome = \propto + \beta_1 X_1 + \beta_2 X_2 + \gamma_1 X_1 * X_2 + \beta_3 X_3 + \delta_j \sum_{j=1}^{15} Age_j + \varepsilon \qquad \textbf{(E1)}$$

Where $Outcome$ is the outcome variable of interest – either total number of days that a patient has been admitted to hospital, or the number of co-morbidities that they are assessed with. The variables on the right-hand side of the equation are:

α is a constant,

X_1 is an indicator of whether the patient is being treated at an OACCP site,

X_2 Is an indicator of whether the OACCP program has been implemented at the patient's treatment hospital,

X_3 is the sex of the patient,

Age_j is an indicator for the age category of the patient,

ε is the error term.

The composition of patients in both the control and treatment group may change over the observation period, which may potentially bias the difference-in-difference estimate. In order to minimise this bias, the age of the patient, number of patient comorbidities, and sex of the patient were added to the regression to control for the changing patient characteristics over the observation period.

The way to interpret the regression model (abstracting from a consideration of the patient age, sex, and comorbidity control variables) is as follows:

- For patients being treated at OACCP program sites before the implementation of the OACCP, the variable X_1=1 and X_2=0, so the average length of stay in hospital for these patients is:

  $$LOS = \propto + \beta_1$$

  One the OACCP program has been implemented, then X_1=1 and X_2=1, so these patients' average length of stay becomes:

  $$LOS = \propto + \beta_1 + \beta_2 + \gamma_1$$

[2] As Patient Length of Stay is a non-negative variable (all values are greater or equal to zero) an Ordinary Least Squares regression is unlikely to be consistent, efficient or unbiased. The model was instead estimated as a Tobit model in order to account for the nature of the dependent variable.

- For patients being treated at non-OACCP hospital sites before the implementation of the OACCP, the variable X_1=0 and X_2=0, so the average length of stay in hospital for these patients is:

  $LOS = \propto$

  One the OACCP program has been implemented, then X_1=0 and X_2=1, so these patients' average length of stay becomes:

  $LOS = \propto + \beta_2$

- The changing length of stay for patients at OACCP and non-OACCP hospitals can be seen to be:

  OACCP hospital patients:

  $$\Delta LOS_{OACCP} = (\propto + \beta_1 + \beta_2 + \gamma_1) - (\propto + \beta_1) = \beta_2 + \gamma_1$$

  Non-OACCP hospital patients:

  $$\Delta LOS_{Non-OACCP} = (\propto + \beta_2) - (\propto) = \beta_2$$

- Therefore the difference in the change of length of stay between OACCP and Non-OACCP hospitals (caused by the introduction of the OACCP) – the difference-in-differences estimate – is:

$$\Delta LOS_{OACCP} - \Delta LOS_{Non-OACCP} = (\beta_2 + \gamma_1) - (\beta_2) = \gamma_1$$

Data on NSW osteoarthritis patient separations between January 2007 and December 2013 over 202 sites was used for this analysis. Osteoarthritis patient separations were defined as those separations with an OA ICD-10-AM diagnosis code (M16.0-M17.9) and with an OA related DRG.

Further details are provided on the data-set are provided in Appendix C.

It should be noted that because not all osteoarthritis patients at the program sites necessarily went through the OACCP, the estimated impact of the OACCP program on average patient length of stay represents the average change in patient length of stay for a patient at an OACCP program site **regardless of whether the patient was enrolled in the OACCP program**. Steps were taken prior to the regression analysis to remove patients from OACCP program sites that had characteristics (age, gender, place of residence) that did not match those in the OACCP database, though a large number of the patients remaining in the OACCP program site cohort are unlikely to have been enrolled in the program.[3]

[3] As the aim of the analysis is to compare the impact of the program on comparable patients that have not gone through the program, this removal of patients serves to make our comparison more accurate. However, as their counterparts in the non-participating sites are equally valid as comparison to those who have gone through the program, the equivalent process was not necessary to undertake for the control group of patients.

2.3.3 Caveats and limitations of approach

The key assumption required for the validity of this estimate is that the two groups, the OACCP hospitals and the non-OACCP hospitals, remain credible treatment and control groups for each other over the evaluation period. This is often called the "parallel trend" assumption – the two groups are assumed to be following the same underlying trend over time, and only differ in whether they have the OACCP program or not.

If there is a factor other than the introduction of the OACCP that affects the average length of stay of patients in one of these groups over the evaluation period, but not the other, then the estimate of the impact of the OACCP on patient length of stay will be biased by this change. For instance, if there is a systematic increase in elective surgeries at the OACCP sites that is unrelated to introduction of the OACCP, and this increase in elective surgeries does not occur at the control sites, the resulting changes in the length of stay may be attributed to the program rather than to the increasing proportion of elective surgeries. Indeed, the coefficient estimates of the regression (presented in Appendix D) suggest that on average, the OACCP hospitals have longer lengths of stay and separations with more comorbidities than the control group of hospitals, giving the OACCP hospitals more room for improvement.

Choosing to take part in the OACCP pilot program may also indicate that the treatment group of hospitals are more focused on OA, and are therefore likely to be engaging in other efforts outside the OACCP program in order to help OA patients, or simply were committing more resources to OA than the control group of hospitals, at the same time as the OACCP program was implemented. The estimated impact of the introduction of the OACCP will capture the net effect of all these efforts, and does not isolate the impact of the OACCP. Another limitation is that this approach estimates the average effect of the program at the hospital level, not at the patient level. Whether this is the statistic of interest will depend on the application – if the question of interest is the impact at a system level for a site that is implementing the program, this is precisely the estimate of interest. However, if the question of interest is concerned with the impact of the program on only those that have entered the program, relative to those who did not, this estimate will significantly under-estimate this impact as a large number of those who did not go through the program are assumed to have done so.

A final and important limitation is that the estimated impact of the implementation of the OACCP program on patient length of stay is the average impact across all OACCP program sites. In reality, the OACCP program was implemented with more fidelity at some program sites than at other program sites, so when all program sites are grouped together to estimate the impact of the program, the estimated impact will understate what would occur if all program sites implemented the program with full fidelity.

3 Process evaluation

This section examines the processes used to implement the OACCP, particularly the key enablers and barriers to implementation. The evaluation domains and questions this section addresses are summarised in Table 3.1.

Table 3.1: Process evaluation domains and evaluation questions

Domain	Evaluation question
Fidelity	What are the key processes used to implement the OACCP at the nominated pilot sites?
	How was the implementation structured at each site and how was it resourced?
Reach and access	How many participants are treated at each site?
Data collection and quality	Did the performance indicators relate to the program and quality improvement?
Enablers, barriers and opportunities for implementation	Key enablers, barriers and opportunities for implementation of the OACCP?
Effectiveness	What outcomes have been achieved for the participants, service providers and the health care system?

3.2 Fidelity

3.2.1 Purpose of the OACCP

As the OACCP Model of Care indicates, the model was developed in line with best practice with the objective of improving coordination of care and adopting an inter-disciplinary approach to the conservative management of osteoarthritis. One of the most important aspects of the OACCP that sites identified was the focus on the underlying comorbidities that were aggravating their osteoarthritis, especially excess weight.

Sites also recognised that the program would contribute to better management of the joint surgical waitlist, as the program allowed patients to be escalated, or be removed from the waitlist as appropriate. However, many also noted that in order for the program to truly effective as a waitlist management program, it needed to target patients much earlier in their OA journey (at primary care stage) in order to prevent those not requiring surgery from entering the waitlist.

Of the patients who were recorded as being discharged from the program, around 64% reported undergoing surgery as their primary reason for discharge between 2011-12 and 2013-14. Of those who were on the surgical waitlist while in the program, 10.7% of knee patients and 4.2% of hip patients were removed from the waitlist because they no longer required surgery. At a site level, Royal North Shore had the highest proportion removed

from the waitlist as they no longer required surgery at 12.07%, while the lowest was at Nepean Blue Mountains at 0.75%[4].

3.2.2 Resourcing of OACCP teams

Across most sites consulted, the typical OACCP team generally comprise:

- a coordinator who is also the program physiotherapist and is the central point of contact between patients and the rest of the OACCP team, managing their initial and ongoing assessments;
- a dietitian who assists patients in managing their lifestyle risks particularly their weight and obesity issues;
- an occupational therapist who assists patients in managing their osteoarthritis around their day-to-day activities including home visits and modifications, and managing pain in daily activities; and
- an administrative support officer who assists with data entry as well as contacting and following up patients on the waitlist, and other administrative tasks.

One site had the addition of a rheumatologist (Royal North Shore) and two sites found it beneficial to have a nurse on the team (Fairfield and Port Macquarie). In some sites such as Bowral and Newcastle, the team only consisted formally of the physiotherapist/Coordinator who referred patients to the relevant services both within the hospital and in the community. While neither Coordinators observed any significant issues with this team model, they did note that sometimes it was difficult to refer patients to private services.

Table 3.2: OACCP team composition and funded FTEs by site

Pilot site	Role	Funded FTE
Bowral	Physiotherapist/Coordinator	0.6 FTE
Gosford	Physiotherapist/Coordinator	0.4 FTE
	Occupational Therapist	0.1 FTE
	Dietitian	0.4 FTE
	Administrative Officer	0.5 FTE
	Physiotherapist	0.8 FTE
Fairfield	Physiotherapist/Coordinator	1.1 FTE
	Physiotherapist	1.0 FTE
	Occupational Therapist	Informally seconded; on referral basis
	Nurse	Informally seconded
Nepean/Blue Mountains	Physiotherapist/Coordinator	1 FTE
	Physiotherapist	0.1 FTE
	Occupational Therapist	Seconded
	Dietitian	Seconded
	Social Worker	0.2 FTE
	Administrative Officer	0.55 FTE

[4] It should be noted that Newcastle recorded 100% of its patients were not removed from the waitlist.

Pilot site	Role	Funded FTE
Royal Newcastle	Physiotherapist/Coordinator	1 FTE
Port Macquarie	Physiotherapist/Coordinator	0.6 FTE
	Dietitian	0.2 FTE
	Administrative Officer	0.2 FTE
	Nurse	0.5 FTE
Royal North Shore	Physiotherapist/Coordinator	1 FTE
	Occupational Therapist	0.2 FTE
	Dietitian	0.4 FTE
	Administrative Officer	0.2 FTE
	Rheumatologist	0.2 FTE
	Social Worker	Informally seconded
	Orthotics	Informally seconded
Sutherland	Physiotherapist/Coordinator	0.3 FTE
	Occupational Therapist	0.2 FTE
	Dietitian	0.1 FTE
	Administrative Officer	0.2 FTE
Wollongong	Physiotherapist/Coordinator	1 FTE
	Occupational Therapist	0.2 FTE
	Dietitian	0.5 FTE
	Administrative Officer	0.5 FTE

Sites recognised the importance of having an experienced coordinator who was able to manage and coordinate the patient care pathway through the program. In addition, many sites noted that in the absence of OACCP, patients rarely had access to a dietitian to manage their weight issues and usually accessed an occupational therapist immediately before or after surgery. This often leads to increased length of stay.

Sites were asked whether there were any additional disciplines that they felt would be beneficial to have in their OACCP teams or to work more closely with as part of the program. As expected, this was highly dependent on the type of patients each site received and the complexities they presented with. Some sites mentioned:

- access to nursing staff e.g. for medication advice;
- access to social worker (as was the case in Royal North Shore who had an unfunded social worker working closely as part of the OACCP team) to work with patients with underlying social issues that may be impacting on their ability to self-manage their condition such as housing; and
- access to mental health teams as depression and anxiety are likely to be linked to pain and less mobility.

In terms of training that people found useful, many noted the training programs held by Health Change Australia. As the OACCP is essentially a behaviour modification and motivational program, Health Change Australia programs developed their skills in:

- patient-centred care and service delivery;

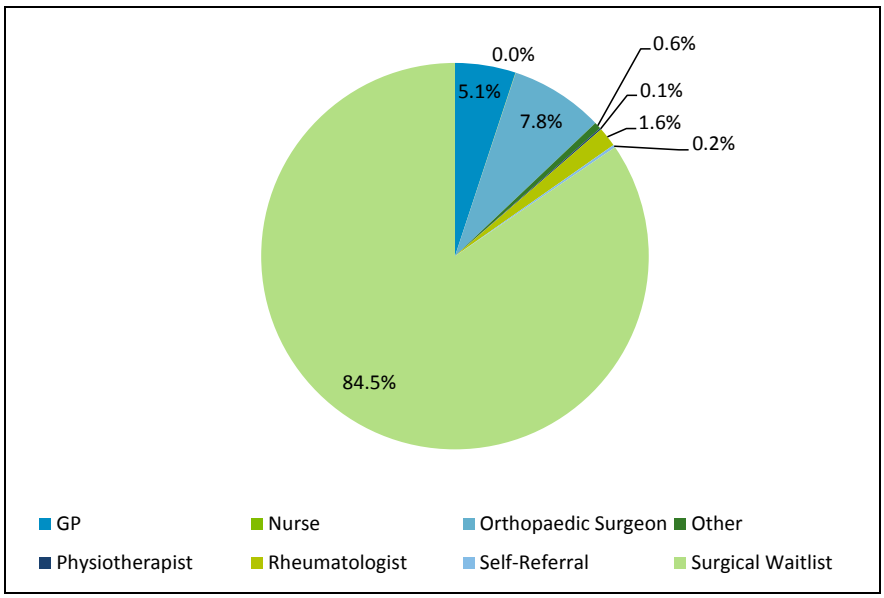
- assessing and building motivation in patients to change and modify their own behaviours; and
- adopting a more multi-disciplinary chronic disease management focus rather than a 'silo' focus.

3.3 Reach and access

3.3.1 Referral process

The OACCP Model of Care specifies that during the pilot phase of the program, most participants will be drawn from the elective joint replacement waiting lists at each of the pilot sites. This is reflected as across all sites, Chart 3.1 shows that around 84.5% of all referrals were from the surgical waitlist during the implementation period.

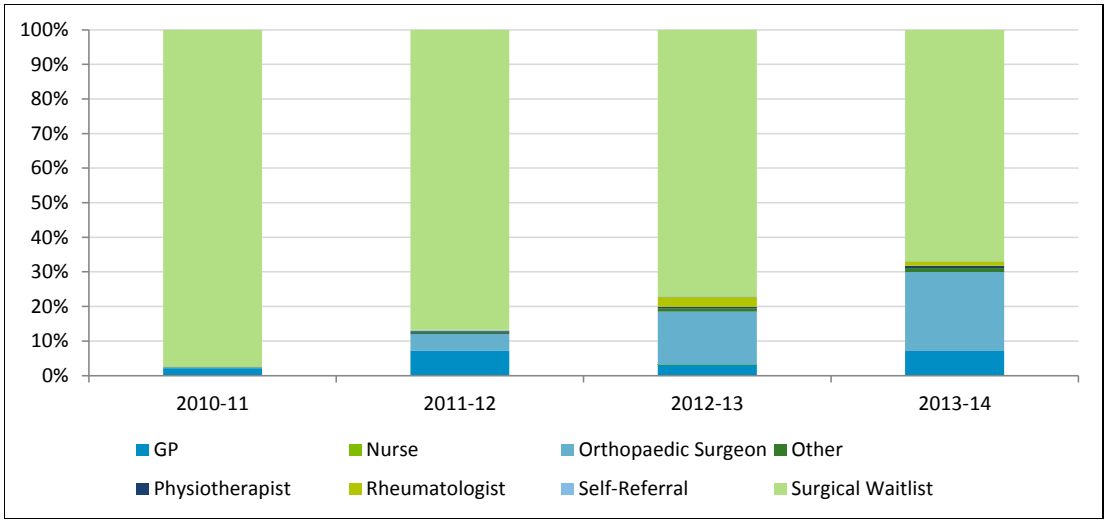
Chart 3.1: Source of referral for all sites (2011-12 to 2012-13)



Source: OACCP Database.

Chart 3.2 summarises the source of referral across all sites by year. While majority of referrals are from the surgical waitlist, there appears to be a steady increase in the proportion of referrals from orthopaedic surgeons. In 2012-13, almost 15.3% of all referrals were by surgeons compared to 4.75% in the previous year. This increase is in line with the findings from the consultations where many noted the initial apprehension of orthopaedic surgeons about the program and its purpose as a waitlist management program. However, many suggested that program buy-in from surgeons improved once they recognised the value of the program, shown through increasing surgeon referrals into the program.

Chart 3.2: Source of referral for all sites by year



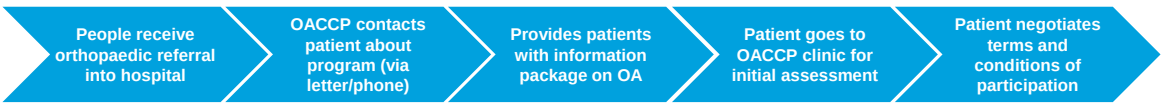
Source: OACCP Database.

The proportion of GP referrals has remained somewhat steady over time at around 5.7% of all referrals between 2011-12 and 2013-14. Several sites attempted opening up the program to GP/Primary Care referrals, but were overwhelmed by the spike in demand and was unable to handle both the waitlist referrals and GP/Primary Care referrals at their current capacity. One site noted that the GP referral process helped to educate GPs and other Primary Health Care providers on chronic care and multidisciplinary and conservative management of OA.

3.3.2 Program intake process

Figure 3.1 summarises the program intake process that was expressed by several sites for people who were not referred directly into the OACCP. People generally received an orthopaedic referral into the hospital and entered the surgical waitlist, and the OACCP Coordinator would check for new entries into the waitlist. These patients will be contacted about the program, and be provided with information about the OACCP and their condition. Sites used a combination of letter and phone to contact patients, but some people noted the limitations in engaging patients via mail. Patients are then invited for an initial assessment before agreeing to participation in the program.

Figure 3.1: Common program intake process



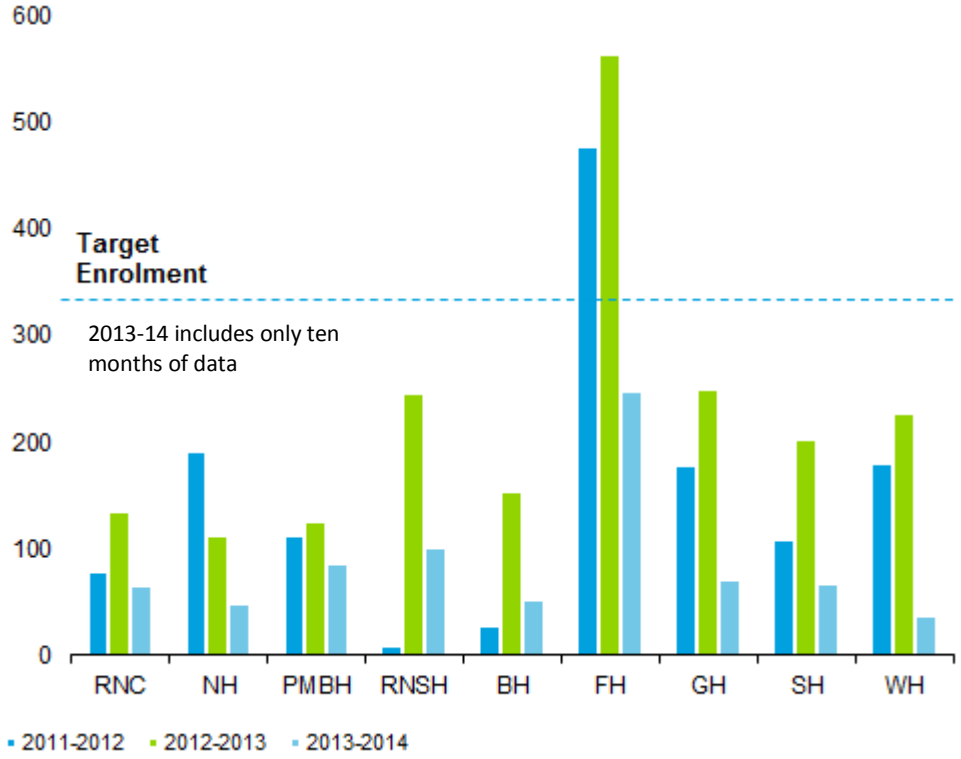
As most sites still have a backlog of patients on the waitlist, some patients may not be contacted about the program for a number of months.

3.3.3 Program uptake

The OACCP Model of Care aimed to enrol 300 participants at each site by the end of 2011-12. From Chart 3.3, it is clear that Fairfield is the only site that assessed more than 300

patients between 2011-12 and 2013-14. However, it is important to note that there was a similar program in 2009 in Fairfield in place prior to the OACCP, as well as in Nepean/Blue Mountains and in Newcastle.

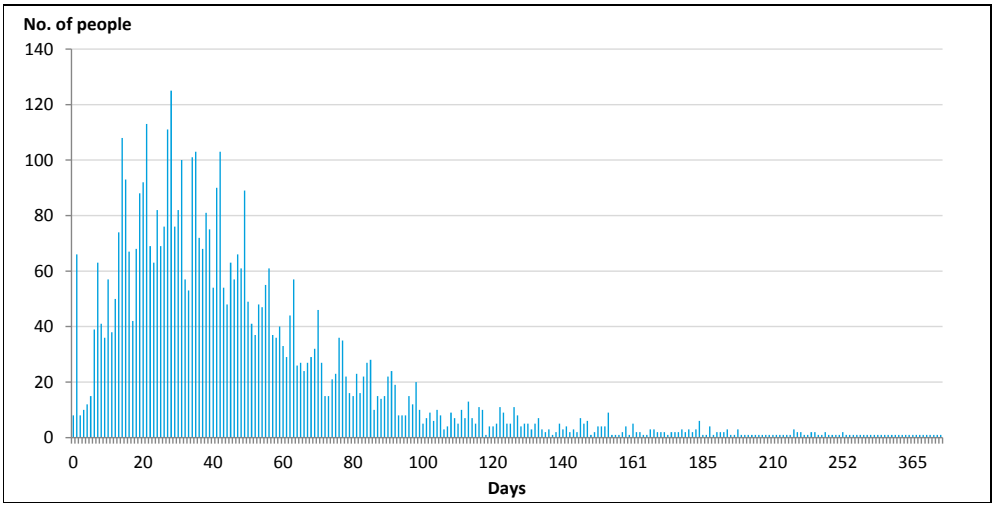
Chart 3.3: Total patients enrolled in OACCP by site and year



Source: OACCP Database.
Note: 2013-14 data excludes June 2014 data as it was unavailable at the time of data extraction.

Between 2011-12 and 2013-14, there were a total of 5,140 patients referred to the OACCP across all sites, with only 0.45% of those patients who did not receive an initial assessment. Chart 3.4 shows the number of days between referral into the OACCP and their initial assessment date. On average, patients waited around 49 days to receive their initial assessment after being referred into the program, with the median waiting time being 37 days. Gosford and Nepean/Blue Mountains had an average of over 70 days between referral and initial assessment, while Bowral, Newcastle and Fairfield averaged less than 40 days.

Chart 3.4: Number of days between referral and initial assessment



Source: OACCP Database.

In terms of the geographic distance which patients travel to attend the OACCP at each site, it appears that a large proportion come from the surrounding Local Government Areas (LGAs). Table 3.3 summarises the LGAs in which patients resided who were in the OACCP by site.

Table 3.3: Pilot site and resident LGAs of patients (2011-12 to 2013-14)

Pilot site	Resident LGAs of patients					
Bowral	Bathurst Regional	Campbelltown	Goulburn Mulwaree	Kiama	Shoalhaven	Wollongong
	Boorowa	Cooma-Monaro	Great Lakes	Queanbeyan	Wingecarribee	
	Camden	Fairfield	Harden	Shellharbour	Wollondilly	
Gosford	Cessnock	Gosford	Lake Macquarie	Wollongong	Wyong	
Fairfield	Ashfield	Botany Bay	Eurobodalla	Hurstville	Penrith	Unincorporated ACT
	Auburn	Camden	Fairfield	Kiama	Shellharbour	Wingecarribee
	Bankstown	Campbelltown	Gold Coast	Lake Macquarie	Sutherland Shire	Wollondilly
	Blacktown	Canada Bay	Great Lakes	Liverpool	Sydney	Wollongong
	Blue Mountains	Canterbury	Holroyd	Parramatta	Tumbarumba	Wyong
Nepean/Blue Mountains	Blacktown	Camden	Gunnedah	Lithgow	Shoalhaven	
	Bland	Campbelltown	Hawkesbury	Liverpool	Wingecarribee	
	Blue Mountains	Fairfield	Holroyd	Penrith	Wollondilly	
Newcastle	Cessnock	Great Lakes	Lake Macquarie	Newcastle	Upper Hunter Shire	
	Dungog	Gunnedah	Muswellbrook	Port Stephens	Wyong	
Port Macquarie	Armidale Dumaresq	Greater Taree	Port Macquarie-Hasting			
	Bellingen	Gwydir				
	Great Lakes	Kempsey	Shoalhaven			

Pilot site	Resident LGAs of patients					
Royal North Shore	Ashfield	Canada Bay	Holroyd	Manly	Upper Hunter Shire	Warrumbungle Shire
	Auburn	Canterbury	Hornsby	Mid-Western Regional	Warringah	Waverley
	Bankstown	Cessnock	Hunters Hill	Mosman	Randwick	Willoughby
	Bathurst Regional	Cootamundra	Hurstville	North Sydney	Rockdale	Woollahra
	Blacktown	Dubbo	Ku-ring-gai	Parramatta	Ryde	Wyong
	Blue Mountains	Fairfield	Lake Macquarie	Penrith	Shoalhaven	
	Botany Bay	Gosford	Lane Cove	Pittwater	Sutherland Shire	
	Campbelltown	Great Lakes	Leichhardt		Sydney	
Sutherland	Ashfield	Fairfield	Rockdale			
	Balranald	Hurstville	Sutherland Shire			
	Bankstown	Kogarah	Wollondilly			
	Canterbury	Marrickville				
Wollongong	Camden	Kiama	Wollondilly			
	Campbelltown	Shellharbour	Wollongong			
	Coonamble	Shoalhaven				
	Holroyd	Sutherland Shire				

Source: OACCP Database.

3.4 Data collection and quality

3.4.1 Data entry and maintenance of database

Across most of the sites consulted, the coordinator is responsible for entering clinical patient data (such as their co-morbidities and their knee and hip osteoarthritis outcome scores) into the OACCP database. Administrative support staff assist in the entering of patient details (such as their age, gender and contact details) in to the OACCP database. In sites where teams included a nurse, the nurse entered the co-morbidities data at initial assessment stage.

Coordinators across several sites noted the duplication in data as the hospital database and the OACCP database are not linked, meaning data needed to be entered twice for every patient. As a result, many indicated the data reporting process to be time consuming and sometimes frustrating as they were unable to extract patient information easily. Some sites also felt that the data requirement put a strain on their patients as they were required to undertake many activities such as the 6MWT and the TUG.

3.4.2 Data use

Majority of the sites consulted acknowledged they did not have access to the OACCP database beyond a patient management capacity. As a result, it was clear that many Coordinators did not have an understanding about the purpose of the data reporting and what the information was being used for.

It was acknowledged that sites received quarterly program reports and annual summaries from ACI, and were able to request specific data easily. However, many also suggested it would be beneficial for them to be able to access the database in order to undertake their own analysis of the program from a continuous quality improvement perspective. As an example, one site noted that they would like to undertake patient characteristic analysis to identify particular cohorts who were more likely to engage fully with the OACCP compared to others. This would allow them to be able to better target individuals who are likely to engage with the program since the OACCP relies heavily on patient motivation in order to achieve optimal outcomes for patients.

3.4.3 Key performance indicators

Some people felt that the key performance indicators did not take into account the positive outcomes of the OACCP that were more qualitative. Some qualitative outcome measures that were mentioned include:

- patients being better prepared for surgery, and having more realistic expectations about surgery and its potential outcomes and impacts;
- ability of the OACCP team to see early on if a patient begins to regress and can then escalate them more appropriately;
- changes in the motivations of patients and their own desires to change and modify their health behaviours in order to improve their health outcomes; and

- post-surgery recovery may be improved e.g. because they had access to an OT early on who was able to make appropriate modifications to their home, or that they no longer had excess weight which was placing stress on their joints.

3.5 Key enablers, barriers and opportunities to implementation

3.5.1 Enablers

One of the factors that sites resoundingly identified as a key enabler to the implementation of the OACCP is strong buy-in from other stakeholders, particularly orthopaedic surgeons, allied health Department Heads, hospital executives and the ACI. In sites where there was a champion or a strong advocate of the program (particularly if they were also a surgeon) within the hospital such as Wollongong, Sutherland, and Royal North Shore, it appeared easier to garner support for the program both from other disciplines and within the hospital's executive. This effect was particularly clear for Wollongong; as the original Coordinator and advocate for the program moved to another hospital, the program began to lose momentum.

Several sites hold regular formal case meetings with the whole OACCP team to ensure patients are receiving consistent and integrated care. Even informal case meetings enable OACCP team members to better synchronise schedules so that patients are able to access more coordinated and streamlined care.

3.5.2 Barriers

For some sites, physical location and space was sometimes found to be a limiting factor. Several sites noted difficulties in needing to compete for on-site gym space as well as office space and infrastructure. Sites in more remote and regional areas found that the physical location of the clinic posed logistical issues for patients who may already not be very mobile due to their OA. The Port Macquarie site travels to several areas in order to reach those patients who have difficulties or are unwilling to travel to the clinic, and therefore otherwise would not have entered the program.

Another challenge for sites was the difficulty in quantifying and presenting the impacts of the program for hospital administrators. Although the program was reported to be very successful, most of these reports are anecdotal and difficult to verify using the data collected. Sites particularly found it hard to justify their program in terms of costs avoided using the information at hand, despite feeling strongly about the program.

Uncertainty about funding was noted as a hindrance in terms of resourcing and staffing of the program. Staff retention was a challenge in some sites, and this negatively impacted on the effective implementation and continuation of the OACCP. This was particularly the case in sites where there had been several changes in the program coordinator, which affects patient's continuity and consistency of care.

A lack of awareness and support for the program within the hospital was cited as a barrier to implementation. Some sites raised awareness of the program by making presentations

to relevant stakeholders (such as hospital executives and allied health department heads). This serves to also build better relationships and networks with other relevant departments, which was identified as crucial to integrated and coordinated patient care.

In sites where funding for the OACCP had been reduced or cut, it was clear that the subsequent decrease in FTEs within the team impacted on the continuity and proper functioning of the program. For example, this was seen in the case of Sutherland where the program was halved, the program did not have capacity to take in as many participants as before.

3.5.3 Opportunities

Many sites intended to take referrals from GPs into the program, but were unable to due to capacity constraints. The program was partly intended to serve a waitlist management function, and as such prioritised patients from the waitlist. Linkages between GPs and the program were also weak at some sites, finding referrals from GPs were sometimes inappropriate (such as patients with acute pain and required surgery immediately).

However, over half of the sites consulted perceived the OACCP as more suited to a community-based model that focused more on prevention and early intervention at the primary care level. Many mentioned that this would in turn address concerns around the orthopaedic waitlist as patients are triaged earlier and will be more appropriately referred to surgery.

Currently, the program mainly targets patients who are already on the surgical waitlist. In Newcastle, there are two waitlists for orthopaedic care – one to see an orthopaedic surgeon and the second to get joint surgery. There is a shift towards targeting patients earlier as they are waiting to see a surgeon rather than those who are already on the surgical waitlist.

As an integrated chronic care program for OA patients, many sites noted the lack of coordination with other chronic care programs (such as diabetes and heart disease chronic care programs) as a significant barrier. While chronic care programs adopt an integrated and multidisciplinary care approach, the existence of similar yet seemingly separate programs means there is significant overlap and duplication between the programs particularly since the existence of comorbidities among patients is common.

It was suggested by some that chronic care programs as a whole could be centralised and therefore more streamlined to provide a more consistent care pathway for patients who have multiple morbidities. For example, the need for health awareness and education is generally common across different chronic care programs such as around dietary requirements, exercise, and management of day-to-day activities.

In addition to these more commonly expressed views, some individuals also mentioned:

- follow up of patients post-discharge from the OACCP to examine their recovery time and experience (for patients who underwent surgery), or to examine their progress on their comorbidities (for patients who were removed from the waitlist); and
- some individuals noted that it would be beneficial to see patients more intensively in the first few months as that is the time when they are making changes to their lives,

while others noted that as a behavioural change and management program, less than three months would be too little time to make behavioural changes.

3.6 Overview of process evaluation

Overall, the biggest factor that contributed to the successful implementation of the OACCP at some sites is strong buy-in from all relevant stakeholders. Many sites recognised the importance of having a champion within the hospital advocating for the program, and securing the support of the hospital executives, allied health department heads and most importantly, orthopaedic surgeons.

In terms of the composition of the team, it is largely dependent on the needs of the patients. In general, almost all sites noted the importance of having an experienced program coordinator/physiotherapist, who was able to be the single point of contact between patients, the rest of the OACCP team, and other relevant stakeholders such as GPs, other allied health teams and orthopaedic surgeons. In addition, most sites recognised the importance of a multidisciplinary team including at a minimum a dietitian and an occupational therapist to assist patients with other comorbidities.

An overwhelming majority of those consulted noted the opportunity for the OACCP to target patients much earlier on in their OA pathway before they see an orthopaedic surgeon. Some went as far to say that the program should be more community-based and take on a more primary prevention focus, rather than targeting patients who are already on the surgical waitlist. This ensures patients are provided with the option of conservative OA management early on leading to potentially better patient outcomes. From the ACI and the program's perspective, earlier intervention may mean better value-add for patient outcomes.

4 Outcomes evaluation

This section examines the short and medium-term outcomes of the OACCP, including an analysis of the outcomes of the program for the health system and patients' clinical outcomes. The evaluation domains and questions this section addresses are summarised in Table 4.1.

Table 4.1: Outcomes evaluation questions

Evaluation questions
What outcomes have been achieved for the patients, service providers, and the healthcare system?
What unexpected outcomes occurred throughout the program, either adverse or positive?
What improvements can be made to the program?
Did the performance indicators relate to the program and quality improvement?

Some sites noted through consultations that in the current iteration of the OACCP, where participants are largely drawn from the surgical waitlist, it may be difficult to observe good outcomes from the program because the program is targeting patients who are already at a more acute stage of their condition. In order to be able to demonstrate the full potential benefit of the OACCP, patients need to be targeted at a much earlier stage of their OA so that the program can achieve its objectives of (1) preventing those who do not require surgery from entering the waitlist and (2) escalating those who require surgery more appropriately.

4.2 Impact on patients' clinical outcomes

This section presents the results of an analysis of the clinical outcomes of patients who completed the full 52 weeks of the OACCP program (i.e. patients who exited early or are still in the process of completing the program are not included). The data for this analysis is drawn from the OACCP database.

4.2.1 Mobility

Two clinical indicators were used from the OACCP database to assess the impact of the program on patient mobility: the 'Timed Up and Go' test (TUG) and the 'Six Minute Walk Test' (6MWT).

The Timed Up and Go test involves measuring in seconds how long it takes (in a controlled setting) for a patient to get up from a chair, walk a short distance, turn around, and sit down again. The Six Minute Walk test involves measuring in metres how far a patient can walk along a track (in a controlled setting) for six minutes.

4.2.1.1 TUG test outcomes

An analysis of TUG test scores shows that patients enrolled into the OACCP program across all program sites on average experienced an improvement in their functional mobility in the

first 26th weeks of the program, but subsequently reversed most of these mobility gains in their last 26 weeks of participation in the program. Patients with osteoarthritis of the hip experienced less of an improvement in their TUG scores than patients with osteoarthritis of the knee.

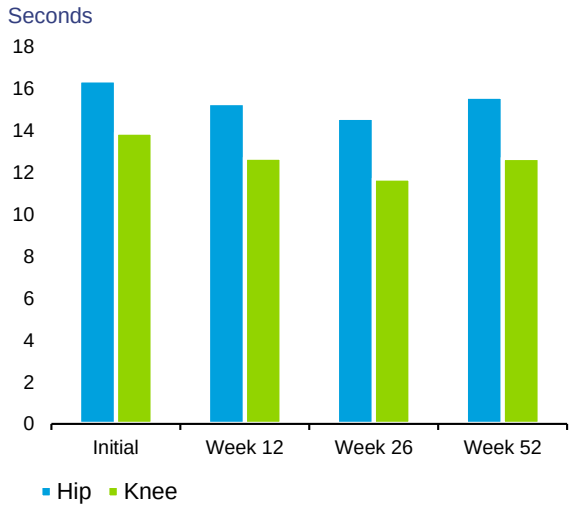
The reason for the average improvement and subsequent relapse in TUG test scores over the course of a patient's involvement in the program could be that patients are initially more committed to the program and self-manage themselves in line with their plans, but then subsequently manage themselves less effectively as they begin to have less contact with the OACCP team, are getting closer to their surgery (and therefore don't see the need of keeping up conservative care), and/or just generally become less enthusiastic about any of their required self-management (for example dietary changes and physical exercise) over time.

A common message from the consultation of staff at program sites was that program success relied heavily on patients being committed and enthusiastic about participation and their self-management. As mentioned in the discussion of the consultation outcomes (Section 3.5.3), some of the staff at program sites suggested patient outcomes could be improved with greater patient contact in the earlier phase of their participation when the patients are most enthusiastic, while other site staff recommended greater contact with patients towards the end of the program where the frequency of contact with the OACCP team is reduced. This result would suggest that, in general, more contact with patients improves their clinical outcomes at any stage throughout the program.

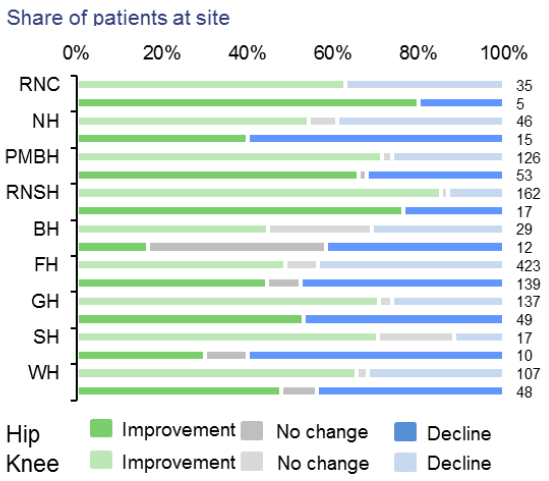
One message from best-practice guidelines is that supervised or group exercise is found to be more effective for patients than when they are left to perform exercises by themselves at home. This could also explain the deterioration in patient outcomes towards the end of their involvement in the program: patients may not have continued exercises at home unsupervised as they were worried that they may injure themselves, or may have been less motivated to exercise without encouragement.

Chart 4.1: TUG test results

Average TUG test score across all sites



Share of patients reporting improvement by site



There was considerable variation in TUG test outcomes across program sites. Royal North Shore hospital experienced the greatest share of patients with osteoarthritis of the knee that recorded an improvement in their TUG test results over the 52 weeks of the program, while a relatively large number of patients at Port Macquarie, and the Gosford hospitals also experienced improvements. The smallest improvement in patient outcomes occurred at the Bowral Hospital.

Some of the strong performance of the Royal North Shore hospital can be attributed to its relatively healthy patient cohort: the patients who enter the OACCP at the Royal North Shore hospital tend to have fewer co-morbidities and relatively higher initial mobility compared to most of the OACCP sites. However, even once the differences in patient characteristics across program sites are taken into account, the Royal North Shore hospital still records the greatest proportion of knee osteoarthritis patients that improve their TUG test results (See Appendix C for a full analysis of clinical outcomes with controls for patient characteristics). Of the other relatively strong performers, the Port Macquarie hospital is notable for having a large proportion of patients with a large number of co-morbidities and poor mobility at the start of the program.

For patients with osteoarthritis of the hip, only the Port Macquarie, Fairfield, Gosford, and Wollongong hospitals have large enough patient samples from which to make a comparison of patient clinical outcomes. Of these hospitals, patients at the Gosford and Fairfield hospitals report the greatest improvement in TUG scores.

4.2.1.2 Six Minute Walk test outcomes

A similar overall pattern of patient progress and reversion is seen for the Six Minute Walk Test as for the Timed Up and Go Test: patient mobility improves over the first 26 weeks of the program, before most of the mobility gains are reversed before the patient completes the program at 52 weeks. Once again, patients with osteoarthritis of the hip experience

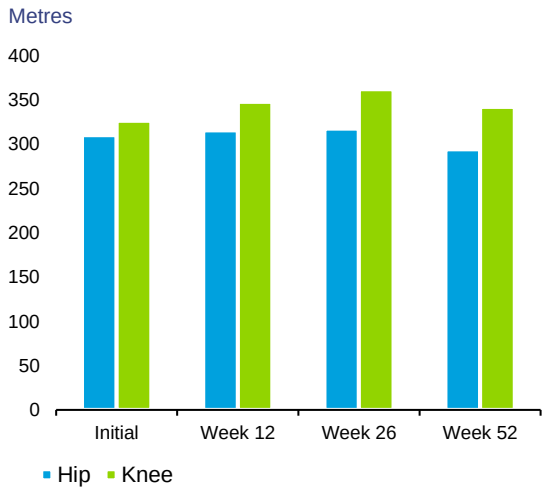
less of an improvement in their test scores compared to patients with osteoarthritis of the knee.

The variation in 52-week patient outcomes across program sites was similar as for the TUG test; once again the Royal North Shore Hospital had the greatest improvement in Six Minute Walk test scores (including once the Royal North Shores' relatively favourable patient characteristics are controlled for) while the Bowral Hospital had the smallest improvement in Six Minute Walk test scores. The Port Macquarie, Gosford, and Wollongong Hospitals also had relatively strong outcomes for older patients, patients with less mobility, and more comorbidities, with patient outcomes in line or close to those achieved by the Royal North Shore Hospital.

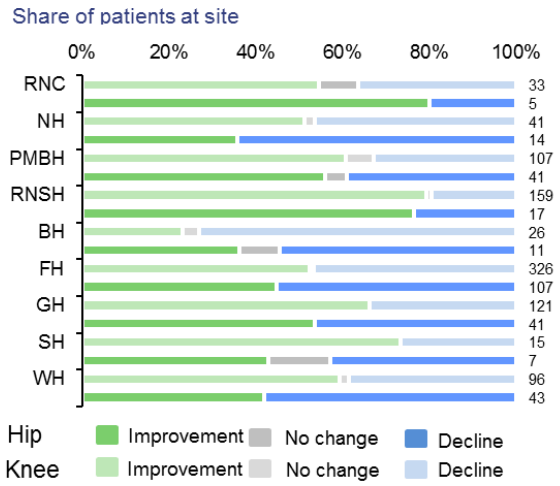
For the hospitals with sizable samples of patients with osteoarthritis of the Hip, patients at the Port Macquarie hospital reported the greatest improvement in Six Minute Walk test scores.

Chart 4.2: Six Minute Walk Test results

Average 6MWT score across all sites



Share of patients reporting improvement by site



4.2.2 Pain

The clinical indicators used to assess the impact of the OACCP on patient's reported pain levels are the Hip disability and Osteoarthritis Outcome Score (HOOS) for patients with osteoarthritis of the hip and the Knee injury and Osteoarthritis Outcome Score (KOOS) for patients with osteoarthritis of the knee.

The KOOS and HOOS are questionnaires developed as instruments to assess a patient's opinion about their knee or hip and associated problems. The questionnaires consist of 5 subscales; Pain, Other Symptoms, Function in Daily Living, Function in Sport and Recreation, and Knee and Hip Related Quality of life. The previous week is the time period considered when answering the questions. Standardized answer options are given on a Likert scale

and each question is assigned a score from 0 to 4. A normalised score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale. The tests are useful for their high test-retest reproducibility.

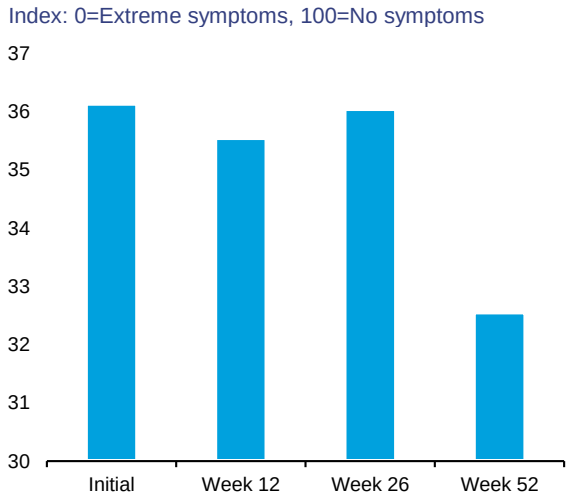
The HOOS Pain scores show that patients enrolled in the OACCP program with hip osteoarthritis on average report generally unchanged pain scores for the first 26 weeks of the program, and then subsequently report lower test scores (indicating greater perceived pain) by the end of the program. For patients enrolled in the program with osteoarthritis of the knee, the KOOS Pain scores show an improvement over the first 26 weeks of the program, before reversing most of the improvement by the end of the program at 52 weeks (which mirrors the pattern seen for the mobility indicators).

There was considerable variation in 52-week patient outcomes across the OACCP sites, with the greatest improvement in pain outcomes for knee patients recorded at the Royal North Shore Hospital (even after accounting for patient characteristics), while the Port Macquarie, Gosford, and Fairfield Hospitals also showed similar strong outcomes to the Royal North Shore Hospital for patients with poor initial mobility, older age, and a large number of comorbidities.

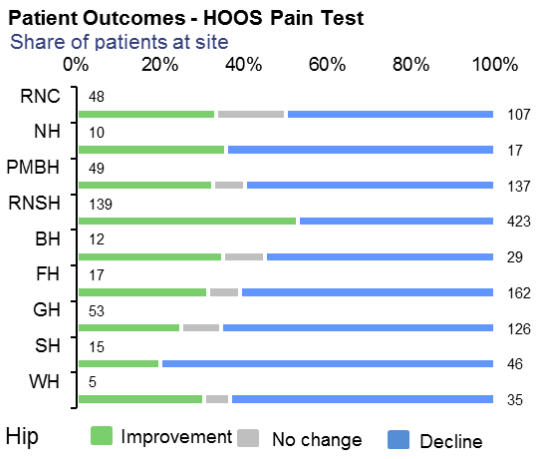
There was less variation in outcomes for patients with osteoarthritis of the hip: all of the hospitals with a sizable sample of patients with osteoarthritis of the hip reported that around a third of hip patients reported an improvement in their pain outcomes over the course of the program.

Chart 4.3: HOOS and KOOS Pain survey results

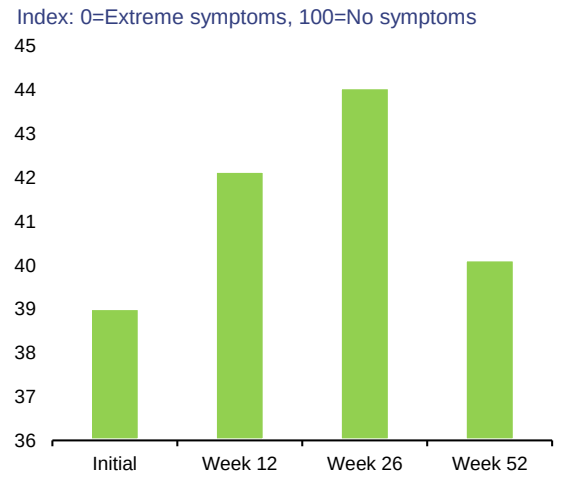
Average HOOS Pain score across all sites



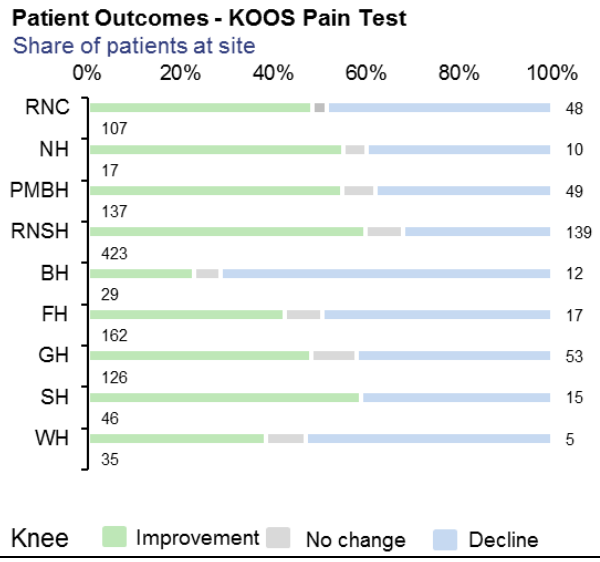
HOOS Pain score change: site comparison



Average KOOS Pain score across all sites



KOOS Pain score change: site comparison



4.2.3 Function in daily living

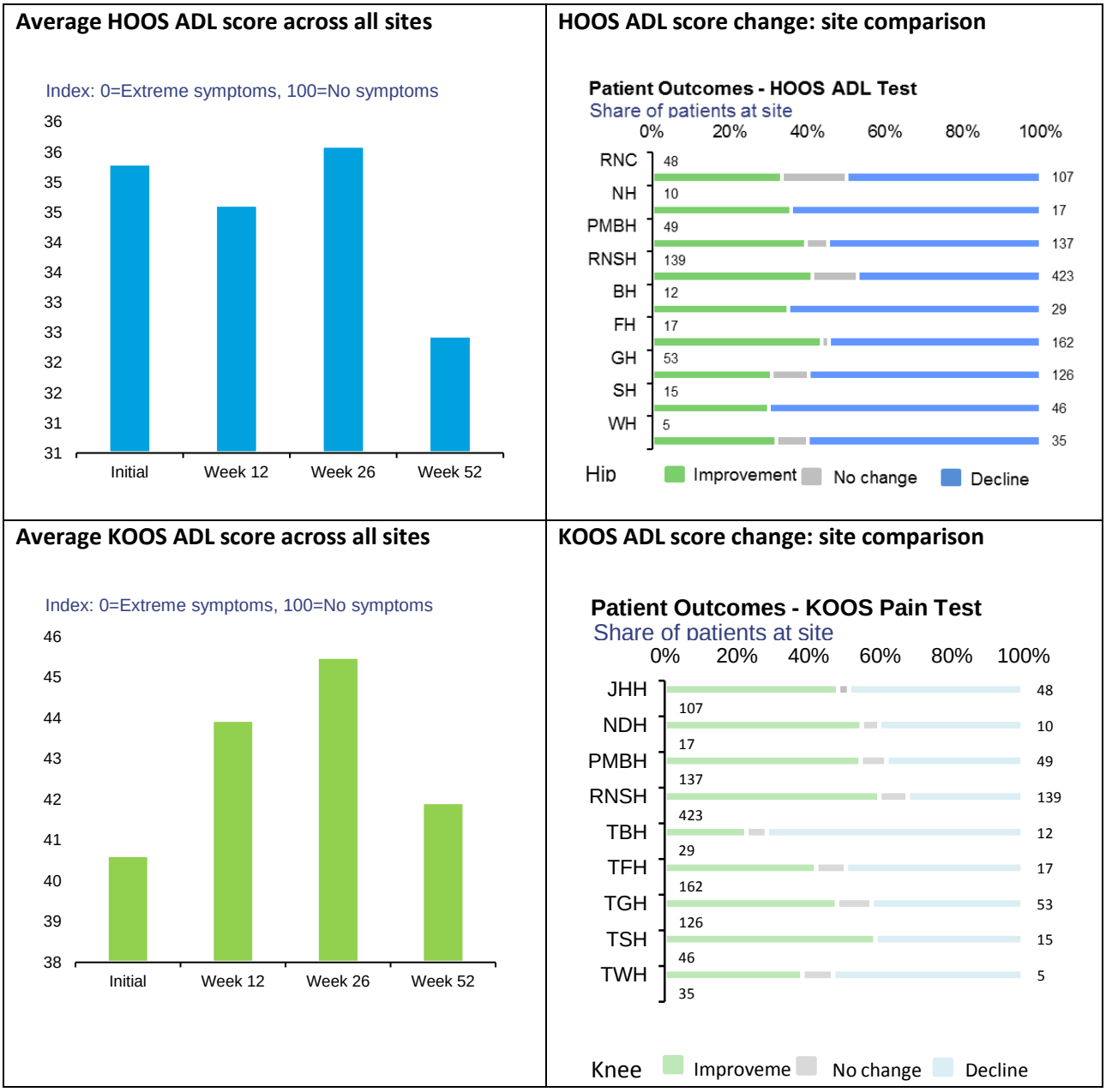
The clinical indicators used to assess the impact of the OACCP on patient's reported functionality in daily living are once again the Hip disability and Osteoarthritis Outcome Scope (HOOS) for patients with osteoarthritis of the hip and the Knee injury and Osteoarthritis Outcome Score (KOOS) for patients with osteoarthritis of the knee.

The outcomes of the HOOS and KOOS results for function in daily living largely mirror the results for pain and mobility: on average, patients with osteoarthritis of the hip report steady function in daily living over the first 26 weeks of the program before reported functionality falls by the time the patient exits the program. For patients with osteoarthritis of the knee, function in daily living improves on average for the first 26 weeks of the program before declining in the final 26 weeks of participation.

Once again there is considerable variation in 52-week patient outcomes across program sites. The Royal North Shore hospital reports the greatest improvement in patient outcomes for patients with osteoarthritis of the knee (the Sutherland Hospital reports a larger improvement but from a small sample) while the Port Macquarie, Fairfield, and Gosford hospitals reported similar improvements in patient outcomes for older patients, patients with a large number of comorbidities, and patients with poor initial mobility.

The Fairfield Hospital reports the greatest improvement in outcomes for patients with osteoarthritis of the hip.

Chart 4.4: HOOS and KOOS Functionality in Daily Living (ADL) survey results



4.2.3.2 Overview of clinical outcomes

Overall the outcomes for the range of clinical indicators provided some consistent findings:

1. The OACCP program resulted in greater clinical improvements for patients with arthritis of the knee compared to patients with osteoarthritis of the hip;

2. Patients tended to have greater improvements in clinical outcomes over the first 26 weeks of the program, with a subsequent loss in in this clinical gains over the final 26 weeks of participation in the program;

3. There was considerable variation in clinical outcomes across program sites; Royal North Shore Hospital is consistently a stand out performer (even after accounting for relatively favourable patient characteristics), with Port Macquarie, and the Gosford hospitals also showing relatively good patient outcomes over a number of clinical indicators. The Port Macquarie hospital is noteworthy for achieving relatively large improvements across a range of clinical outcomes for older patients, patients with relatively poor mobility, and patients with a relatively large number of comorbidities upon entry to the program.

4.3 Osteoarthritis management and care pathway

Many sites indicated that prior to the OACCP, the typical osteoarthritis treatment path included referral to an orthopaedic surgeon who then placed the patient on the surgical waitlist. Most noted the lack of focus on chronic care and disease management, particularly around the complex needs patients presented with regularly such as excessive weight. This was generally attributed to the lack of awareness and education to patients around preventative and conservative management options.

When sites were asked about their perceptions of the impact of the OACCP on patient outcomes, many cited the qualitative outcomes as key, including:

- as patients are assessed at 3, 6 and 12 months, the OACCP team is able to identify immediately if patients are deteriorating or regressing while they are in the program and are best placed to escalate them to surgery; and
- some sites noted a decrease in surgery cancellations, especially late notice cancellations, as patients are better prepared for surgery and escalations are better managed.

4.4 Impact on admitted patient length of stay

This section presents an analysis of the impact of the OACCP on two outcomes: (1) the average length of stay for each patient undergoing a knee or hip replacement, and (2) the number of co-morbidities that each patient is diagnosed with. The primary indicator of how the implementation of the OACCP affected service providers and the health system was to look at how the implementation of the program affected the average length of patient admissions in hospital. If the program is successful in reducing patient length of stay, this improves the use of resources in the health system, and also benefits the patient. Analysing the effect of the introduction of the OACCP on the average number of patient comorbidities is a useful indicator of the impact of the program on patient health outcomes.

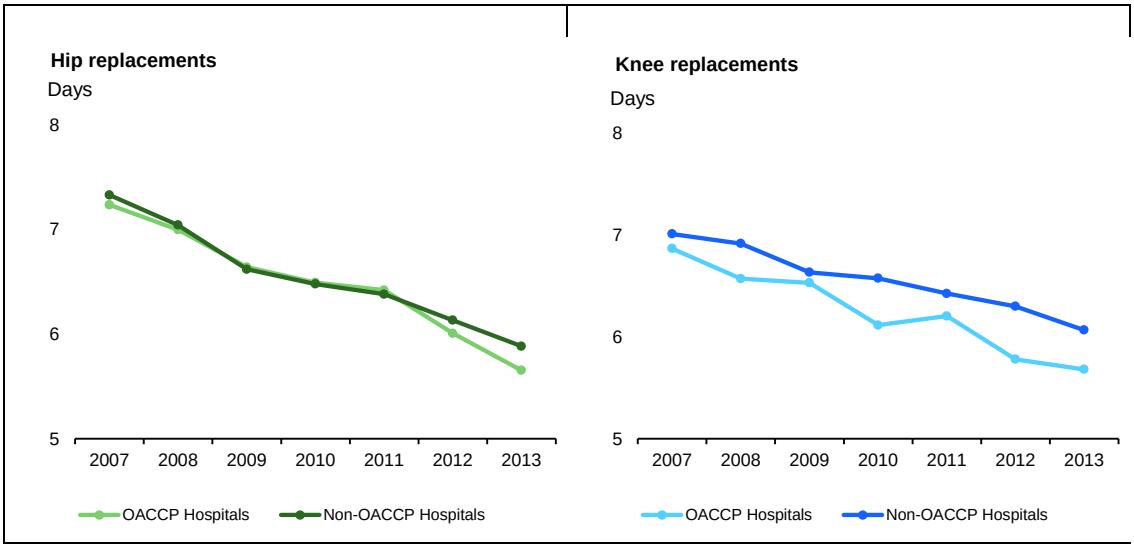
This section presents a summary of the results of equation E1 (described in the methodology section) which is used to estimate the impact of the introduction of the OACCP on the average length of patient stay and average number of patient comorbidities at program sites. An important caveat for this analysis is that the estimated effects of the introduction of the OACCP on patient length of stay and number of comorbidities is for all osteoarthritis patients at program sites, regardless of whether the patient participated in the OACCP or not. Steps were taken prior to the analysis to remove patients from OACCP

program sites that had characteristics (age, gender, place of residence) that did not match those in the OACCP database, though a large number of the patients remaining in the OACCP program site cohort are unlikely to have been enrolled in the program. Therefore it is reasonable to expect that the estimated effect of the OACCP program will be somewhat weaker than if OACCP patients were able to be separately identified.

4.4.1 Estimated impact on patient length of stay

Taking a broad look at the average length of stay for hip and knee replacement separations in NSW, it can be seen that hospitals that run the OACCP have, on average, lower lengths of stay for knee and hip replacement separations than hospitals that have not implemented the program; this is the case both before and after the introduction of the OACCP (Chart 4.5). Following the introduction of the OACCP across program sites between 2010 and 2011, the average length of stay at hospitals that run the OACCP appears to fall even further relative to non-OACCP hospitals (this decline is in the context of a broader decline in the length of stay for hip and knee replacement separations in NSW since at least 2007).

Chart 4.5 Average length of stay for hip and knee replacement separations in NSW



An econometric analysis was undertaken to assess whether the relative decline in average length of stay for knee and hip replacement separations at OACCP hospitals following the implementation of the program could be causally attributed to the program implementation. The analysis is split for patients with osteoarthritis of the knee and patients with osteoarthritis of the hip, as the effectiveness of the OACCP may be different for these two groups. Overall, we do not find a statistically significant impact on the average length of stay for knee or hip replacement separations for patients at hospitals participating in the OACCP compared to patients at hospitals not participating in the OACCP. Full results are presented in Appendix D. The estimated effect is not statistically significant at any conventional levels of significance. Indeed, the standard error of the estimated effect is quite large, suggesting that the OACCP had a materially different impact on length of stay for different patients (perhaps due to a range of patient characteristics that cannot be controlled for with the data set that was used).

This result does not rule out that the OACCP reduces the average patient length of stay for knee or hip replacement separations; in order to more definitively test the hypothesis that the OACCP reduces patient length of stay, it would be necessary to (1) more completely control for more patient characteristics by gathering more patient data (one way that this could be done is to link the admitted patient hospital data set to OACCP program data to incorporate clinical indicator information), and (2) to only include patients who participated in the OACCP in the treatment group, which was unachievable with the available data. It would also be prudent to track follow-up subacute separations (i.e. surgical follow up and rehabilitation) for OACCP patients who have had a knee or hip replacement, as it is reasonable to think that the OACCP may have a larger effect on reducing follow-up separations than acute surgical separations.

4.4.2 Estimated impact on patient comorbidities

Following the analysis of the introduction of the OACCP on the average length of stay for patients, we also tested the hypothesis that the introduction of the OACCP impacts the average number of comorbidities for patients at hospitals that have implemented the OACCP (though once again OA patients that participate in the OACCP cannot be separated from OA patients who did not participate in the OACCP at these hospitals). The purpose of this analysis was to quantitatively test a theme that emerged from the qualitative evaluation: that participation in the OACCP could improve a participant's management of other chronic illnesses and health problems, such as diabetes, obesity and hypertension. The OACCP could potentially improve participant's management of diabetes, obesity, and hypertension through three different channels:(1) the program may aid participants in managing their comorbidities, (2) the program may, as an unintended benefit, eliminate a participant's comorbidity, or (3) participation in the program may have prevented a comorbidity from being developed in the first place. The data set that we have available only allows us to test whether participation in the OACCP is correlated with less comorbidities for patients at hospitals that have implemented the OACCP (consistent with comorbidities being eliminated or prevented).

As Table 4.2 shows, it is estimated that the introduction of the OACCP is correlated with a small reduction in the number of comorbidities at hospitals implementing the program compared to hospitals that did not. The OACCP implementation is correlated with a 1% fall in the likelihood of hip and knee osteoarthritis patients being obese, and a reduction in the likelihood of a patient having hypertension by 2.7%. There was no statistically significant impact of the OACCP on reducing the incidence of diabetes as a comorbidity in patients.

Table 4.2: Impact of the OACCP on patient comorbidities

	No. of Observations	% of separations diagnosed with comorbidity	Marginal Effect (Std. Error)
Diabetes	121,289	8.3%	-0.7%* (0.4)
Obesity	121,289	1.6%	-0.7%*** (0.1)
Hypertension	121,289	8.9%	-2.7%*** (0.4)

Note: * indicates statistically significant at the 10% level of confidence, ** indicates statistically significant at the 5% level of confidence, *** indicates statistically significant at the 1% level of confidence. Marginal effect was evaluated at the average.
Source: Estimates using hospital separations dataset.

Taken together, these results show that, on average, the implementation of the OACCP did not significantly change the average length of stay for individuals with OA of the knee and/or hip that had joint replacement surgery at an OACCP hospital, but did lead to a modest reduction in the prevalence of obesity and hypertension within this cohort.[5] The result of a slight reduction in some patient comorbidities is consistent with the qualitative assessment of the program: with the focus on a more holistic model of care, and emphasis on dietician support and regular exercise within the program, the OACCP can complement other chronic-disease management programs, with many of the conservative care measure that are beneficial for OA also being beneficial for the prevention and management of diabetes, obesity and hypertension.

4.5 Impact on orthopaedic waitlist

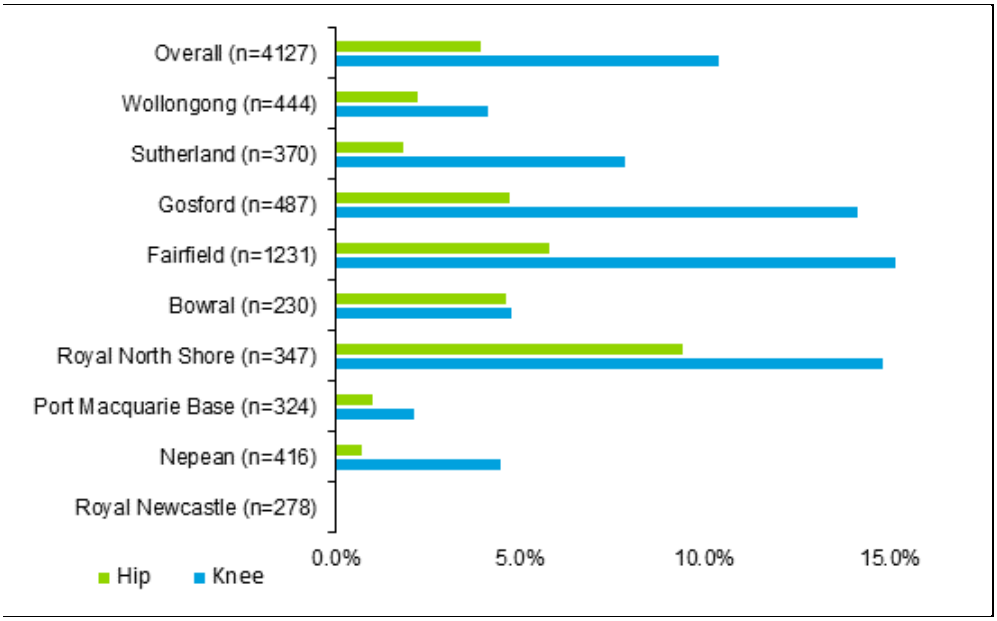
A key objective of the OACCP program is to improve management of surgical waitlists for hip and knee replacements. An analysis of the reasons for discharge of patients from the OACCP shows that almost all patients leave the program in order to receive surgery, or are discharged from the program while still waiting for surgery.

Data limitations prevent the calculation of patients whose surgery for knee or hip replacements were escalated. However, the data show that of those who were removed from the waitlist while in the OACCP across all the sites, 4.2% of hip patients and 10.7% of knee patients were removed because they no longer required surgery (Figure 4.1). These data only include patients who had completed the full program.

While a higher rate of participant removal from surgical wait lists is a good outcome, without additional information it is not clear that program sites that had a low proportion of patients removed from waitlists were necessarily performing worse: for hospitals with less patients removed from waitlists, it could be the case that surgeons were more conservative about placing patients on the surgical wait list in the first place.

[5] Although the estimate on diabetes is not statistically significant at the standard 5% level of significance, it is marginally significant (10% level) and is suggestive of the impact of the OACCP on this cohort of patients.

Figure 4.1 Share of OACCP waitlist removals that no longer require surgery



4.6 Overview of outcomes evaluation

Overall, the available evidence suggests that the OACCP program can significantly improve clinical outcomes (i.e. functionality, mobility, and pain) for participants with osteoarthritis of the knee, while only providing modest improvements for patients with osteoarthritis of the hip; this result may suggest that, going forward, patients with osteoarthritis of the knee be targeted for conservative management, while patients with osteoarthritis of the hip generally benefit only from other aspects of the program, such as monitoring and preparation for surgery. The relatively stronger outcome for patients with osteoarthritis of the knee is consistent with relatively larger share of knee replacement waitlist removals no longer requiring surgery (around 11% on average across sites) relative to hip replacements (around 4% on average across sites). There is also evidence that the implementation of the OACCP at a hospital is correlated with a slight reduction in the likelihood of a patient being diagnosed with obesity or hypertension; this result suggests that it is valuable to consider the OACCP as part of a management strategy for patients with a number of chronic disease comorbidities. There is no statistically significant impact of the OACCP on the length of patient stay for a hip or knee replacement, though a number of improvements to the data analysis strategy in the future may allow the impact of the OACCP on patient stay to be measured more accurately.

A consistent pattern observed in the analysis of clinical outcomes was that patients' mobility, functionality and pain indicators improved in the first 26 weeks of the program, before mostly reverting back by the time the patients exited the program at 52 weeks. This result, along with feedback from site consultations that patients benefit from greater clinical contact and supervision, suggest that patients would benefit from greater contact with OACCP teams in order to support their self-management, particularly in the second-half of the program where patients are only assessed once, upon their exit from the program.

The analysis of clinical outcomes also revealed considerable variation in clinical outcomes across program sites; Royal North Shore Hospital is consistently a stand out performer, even after controlling for its relatively favourable patient characteristics, with the Port Macquarie and Gosford hospitals also showing relatively good patient outcomes over a number of clinical indicators. The Port Macquarie Hospital was noteworthy for producing relatively good outcomes for its patients over a range of clinical indicators, despite having a large number of older patients, patients with relatively poor mobility measures and a large number of comorbidities when entering the program. It would be prudent for teams at other OACCP program sites to learn from the implementation and experiences of the teams at these better performing hospitals in order to improve patient outcomes across the program and at any new program sites. One standout feature of the Royal North Shore Hospital site in particular was the buy-in to the program by Orthopaedic surgeons within the hospital, highlighting the importance of staff buy-in as a key enabler to the success of the program. Another feature of the Royal North Shore Hospital program site was the large multidisciplinary team that provided a comprehensive range of services to program participants.

The analysis of hospital data for osteoarthritis patients in NSW showed that patients with osteoarthritis of the knee or hip at OACCP program sites experienced a statistically significant decline in some comorbidities (obesity and hypertension) following the introduction of the OACCP. The reduction in these patient comorbidities, along with benefits of the program in preparing patients for surgery and rehabilitation, could be expected to have contributed to the modest decline in admitted patient length of stay for acute and sub-acute separations at OACCP program sites for patients with osteoarthritis of the knee following the implementation of the program, though no statistically significant reduction in length of stay was measured for acute separations. Going forward, the accuracy of the estimate of the impact of the OACCP on patient length of stay could be improved by (1) controlling for more patient characteristics that affect length of stay, and (2) separately identifying patients who participated in the OACCP from other osteoarthritis patients at OACCP hospitals; it would also be prudent to identify sub-acute follow up and rehabilitation separations for patients who receive a hip or knee replacement, to estimate the impact of the OACCP on these sub-acute separations. By being able to more accurately measure the impact of the OACCP on patient length of stay in hospital, a better assessment will be able to be made of the impact of the OACCP on the efficient use of resources at program sites.

In relation to improved waitlist management, which is ultimately a key objective of the program, the implementation of the OACCP resulted in a modest removal of patients from the waitlist for knee replacements because they no longer require surgery (around 11% of patients removed from waitlists on average across all sites) and a more modest removal of hip replacement patients (around 4% on average across all sites); the relatively stronger outcomes for preventing or delaying knee replacements relative to hip replacements is consistent with the relatively stronger clinical outcomes for knee osteoarthritis participants while in the program. Staff at program sites also reported a reduction in surgery cancellation, and that patients were generally better prepared for surgery and rehabilitation. As discussed in the process evaluation, if the program were further expanded to a primary care setting, before patients were placed on surgical waitlists, the program may have a greater impact on reducing the number of patients that ultimately receive knee and hip replacements.

Appendix A: OACCP program logic

Problem definition	inputs		outputs		Outcomes		
	change management →		implementation →				
	Inputs and baseline	Activities	Activities	Outputs	short	intermediate	long
In 2007, an estimated 3.85 million Australians had arthritis with over 1.6 million of these self-reporting they have OA. 2.4m of these were of working age resulting in the burden of disease impacting productivity costs and direct health care costs at $24 billion. Arthritis is most prevalent in people aged 65 years and over and this is set to increase significantly with population ageing placing considerable burden on the healthcare system. Research of best practice guidelines indicates that physical and psychosocial management of osteoarthritis improves individual disease management and outcomes	• One off grant from Ministry of Health • Establish system utilisation, cost and variance across sites • Identify clinical need for program • Develop program logic, evaluation framework and key indicators	• Finalise OACCP model of care document • Develop implementation and communication plan • Develop position descriptions for coordinator role develop policy and procedures guide • Establish OACCP multidisciplinary teams at each site • Identify and recruit eligible participants • Develop service directories • Develop clinical pathways • Develop education package for participants around management of osteoarthritis • Development of a data	• Dedicated OACCP teams established • Care coordination occurring across relevant settings – health service site, community accessed services, self directed and supported interventions • Care management plans developed with all participants • Health education that promotes self management developed and includes physiological management, exercise and weight loss information and support, psychological needs addressed • Collaboration with Medicare Locals and other relevant care providers to	• Comprehensive multi-disciplinary patient assessments including disease management • Relevant interventions and referral delivered • Patients provided with health education and information about disease management that promotes self management • Where required, participants escalated on waitlist for surgical intervention • All relevant stakeholders included in OACCP MDT • Communication	• Delay or removal from joint replacement surgery waitlist where appropriate • Increased capacity of participants to self manage health • Improved coordination of care and interdisciplinary conservative management • Collaborative planning and goal setting	• Increased capacity of staff to work within a chronic care model • Improved referrals and coordination between staff, patients and other relevant service providers • Improved satisfaction with service delivery – participants and clinical partners • Improved data on incidence, costs and outcomes • People recruited to the program receive services in appropriate care settings (eg has there been a shift from an inpatient to non-admitted setting, unmet need)	• Manage and control symptoms • Optimise and maintain function • Optimise and maintain quality of life • Reduce healthcare costs • Improve the patient journey and outcomes of elective joint replacement patients • Optimise the patient outcomes for people removed from the surgical waitlist

Problem definition	inputs		outputs		Outcomes		
	change management →		implementation →				
	Inputs and baseline	Activities	Activities	Outputs	short	intermediate	long
		system to support the OACCP	appropriately assess, manage and refer OACCP and potential OACCP patients • Data collection system established	with other relevant service providers		• Participants proceeding to surgery are in optimal condition physically and psychologically.	

Appendix B: Process evaluation interview questions

Table B.1: Questions for semi-structured interviews

Domain	Evaluation question	Interview questions
Fidelity	What are the key processes used to implement the OACCP at the nominated pilot sites?	When and how was the program implemented at the site?
		Who is responsible for entering data in to the OACCP system? Is this an effective way of entering data, and are there any improvements required for the data collection process?
		Has the care and/or health management options for OA patients improved since implementation of OACCP? How has it improved?
		What are the key enablers and barriers in the implementation and effective operation of the OACCP?
	How was the implementation structured at each site and how was it resourced?	How many people are in the OACCP team? What is each person's background and role?
		Was any specific training provided at implementation, or are any areas of training deemed necessary for staff in OACCP teams?
		What strategies were used to inform staff outside of the OACCP team about the program? Do you feel other staff are aware of the program?
		What are some of the key enablers and challenges to collaboration and integration across sectors and professions?
Reach and access	How many participants are treated at each site?	What are the criteria for participant eligibility? How is this determined? Do you think the criteria may need to be adjusted?
		How is the referral process structured for patients to enter the OACCP? Is this appropriate?
		What are the complexities that patients generally present with and how are these managed?

Data collection and quality	Did the performance indicators relate to the program and quality improvement?	What key performance indicators were developed to monitor and assess the OACCP?
		How has your team used performance indicators for continuous quality improvement in the management of OA, and the operation of the OACCP?
Unintended impacts	What unexpected outcomes occurred throughout the program either adverse or positive?	
Effectiveness	What outcomes have been achieved for the participants, service providers and the health care system?	What are your perceptions of the initial impacts of the OACCP on patients?
		Do you think the OACCP has improved the coordination of care for clients and their capacity to self-manage their OA?

Appendix C: Data Appendix

Relevant excerpt of data request:

We would like to request all of the admitted patient and elective surgery data that the ACI has requested for the OACCP program, with an extension of the data sets to include (1) a longer time series, (2) additional variables, and (3) An additional set of data from the National Hospital Cost Data Collection.

Specifically, we would like to request admitted patient data for the three patient cohorts specified in the ACI's admitted patient and elective surgery data request for the OACCP program, with the three patient cohorts being:

1. Osteoarthritis of the Knee and Hip Cohort, defined as patients with the following ICD codes:

ICD-10-AM code	ICD-10-AM descriptions
Hip Osteoarthritis (Coxarthrosis M16.-)	
M16.0	Primary Coxarthrosis Bilateral
M16.1	Other primary coxarthrosis
M16.2	Coxarthrosis resulting from dysplasia, bilateral
M16.3	Other dysplastic coxarthrosis
M16.4	Post-traumatic coxarthrosis, bilateral
M16.5	Other post-traumatic coxarthrosis
M16.6	Other secondary coxarthrosis, bilateral
M16.7	Other secondary coxarthrosis
M16.9	Coxarthrosis, unspecified
Knee Osteoarthritis (Gonarthritis M17.-)	
M17.0	Primary gonarthrosis, bilateral
M17.1	Other primary gonarthrosis
M17.2	Post-traumatic gonarthrosis, bilateral
M17.3	Other post-traumatic gonarthrosis
M17.4	Other secondary gonarthrosis, bilateral
M17.5	Other secondary gonarthrosis
M17.9	Gonarthrosis, unspecified

When the data was received, the following variables were created:

- A dummy variable for whether the separation took place at an OACCP site (with a number of observations being edited for definitely not taking part in the program);
- A dummy variable for whether the separation took place after the implementation of the OACCP (different dates for the OACCP sites, 1 March 2011 for all other sites);
- A dummy variable for whether the separation has a rehab or follow-up related ICD-10 diagnosis code;
- A dummy variable for whether the separation had a Knee OA diagnosis; and
- A dummy variable for whether the separation had a Hip OA diagnosis.

The Acute DRGs are:

Admitted patients with the following DRGs:

I03A	Hip Replacement W Catastrophic CC
I03B	Hip Replacement W/O Catastrophic CC
I04A	Knee Replacement W Catastrophic or Severe CC
I04B	Knee Replacement W/O Catastrophic or Severe CC

And/or with the following procedure codes:
49517-00
49518-00
49519-00
49315-00
49318-00
49319-00

The data was then input into R (http://www.r-project.org/), a commonly used statistical package.

The following commands were then input into the R console:

```
oaccp_reg <- read.csv(file="OACCPLOSFINAL.csv")

names(oaccp_reg)[names(oaccp_reg) == 'episode_length_of_stay'] <-
'LOS'
names(oaccp_reg)[names(oaccp_reg) == 'OA'] <- 'OACCP'
names(oaccp_reg)[names(oaccp_reg) == 'age_grouping'] <- 'age'

oaccp_reg <- subset(oaccp_reg, Knee == 1 | Hip == 1)

AcuteKnee <- subset(oaccp_reg, AcuteOA == 1 & Knee == 1)
AcuteHip <- subset(oaccp_reg, AcuteOA == 1 & Hip == 1)
RehabKnee <- subset(oaccp_reg, Rehab == 1 & Knee == 1)
RehabHip <- subset(oaccp_reg, Rehab == 1 & Hip == 1)
```

The code above simply uses the first cohort of the data (described above), renames the variables, and then creates the subsets of data used for the analysis.

Appendix D: Regression results

Eight tobit difference-in-difference regressions were run in total. Full regression results, before calculation of marginal effects, are provided below. The commands used to run the analysis are given at the top of each regression table.

Length of Stay:

Tobit difference-in-difference on OA knee separations with acute DRGs without a follow-up related ICD-10 diagnosis code

```
                 Marg. Eff. Std. Error  t value  Pr(>|t|)
OACCP             -0.319347   0.069353  -4.6047 4.138e-06 ***
After             -0.430795   0.034904 -12.3423 < 2.2e-16 ***
sexMale           -0.327161   0.032623 -10.0285 < 2.2e-16 ***
age15 - 19 years  -0.051975   3.851374  -0.0135   0.98923
age20 - 24 years   2.358823   3.515847   0.6709   0.50228
age25 - 29 years   5.815930   3.476531   1.6729   0.09435 .
age30 - 34 years   4.139946   3.241482   1.2772   0.20154
age35 - 39 years   4.110934   3.175385   1.2946   0.19545
age40 - 44 years   4.149261   3.153467   1.3158   0.18825
age45 - 49 years   3.857631   3.147357   1.2257   0.22033
age50 - 54 years   4.154309   3.145623   1.3207   0.18662
age55 - 59 years   4.389954   3.145141   1.3958   0.16278
age60 - 64 years   4.422948   3.144984   1.4064   0.15962
age65 - 69 years   4.574813   3.144942   1.4547   0.14577
age70 - 74 years   4.811817   3.144940   1.5300   0.12602
age75 - 79 years   5.237626   3.144983   1.6654   0.09584 .
age80 - 84 years   5.636683   3.145141   1.7922   0.07311 .
age85+ years       6.439766   3.145784   2.0471   0.04065 *
OACCP:After        0.054404   0.099298   0.5479   0.58377
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Tobit difference-in-difference on OA hip separations with acute DRGs without a follow-up related ICD-10 diagnosis code

```
                 Marg. Eff. Std. Error  t value Pr(>|t|)
OACCP             -0.117330   0.075229  -1.5597   0.1188
After             -0.656629   0.036593 -17.9441   <2e-16 ***
sexMale           -0.465018   0.034317 -13.5506   <2e-16 ***
age15 - 19 years  -0.403357   2.265999  -0.1780   0.8587
age20 - 24 years  -1.449067   2.171824  -0.6672   0.5046
age25 - 29 years  -1.275023   2.128298  -0.5991   0.5491
age30 - 34 years  -0.982064   2.102539  -0.4671   0.6404
age35 - 39 years  -0.774642   2.089111  -0.3708   0.7108
age40 - 44 years  -1.062177   2.083671  -0.5098   0.6102
age45 - 49 years  -0.921130   2.081408  -0.4426   0.6581
age50 - 54 years  -0.897784   2.080444  -0.4315   0.6661
age55 - 59 years  -0.624454   2.080053  -0.3002   0.7640
age60 - 64 years  -0.464606   2.079856  -0.2234   0.8232
age65 - 69 years  -0.186448   2.079794  -0.0896   0.9286
age70 - 74 years   0.184327   2.079794   0.0886   0.9294
age75 - 79 years   0.724840   2.079862   0.3485   0.7275
age80 - 84 years   1.356129   2.080065   0.6520   0.5144
age85+ years       2.338549   2.080799   1.1239   0.2611
OACCP:After        0.117591   0.109288   1.0760   0.2819
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Newton-Raphson maximisation, 6 iterations
Return code 1: gradient close to zero
Log-likelihood: -123804 on 21 Df
```

Comorbidities:
Tobit difference-in-difference on all separations, Diabetes, Marginal Effects at Mean

```
                 effect  error t.value p.value
(Intercept)      -0.917 15.819  -0.058   0.954
OACCP             0.025  0.004   6.264   0.000***
After             0.037  0.002  18.190   0.000***
sexMale           0.010  0.002   6.836   0.000***
age15 - 19 years -0.006 16.400   0.000   1.000
age20 - 24 years -0.006 15.375   0.000   1.000
age25 - 29 years  0.928  0.315   2.948   0.003**
age30 - 34 years  0.926  0.723   1.281   0.200
age35 - 39 years  0.929  0.521   1.784   0.074.
age40 - 44 years  0.934  0.300   3.114   0.002**
age45 - 49 years  0.941  0.466   2.022   0.043*
age50 - 54 years  0.957  0.668   1.432   0.152
age55 - 59 years  0.974  0.770   1.265   0.206
age60 - 64 years  0.985  0.758   1.299   0.194
age65 - 69 years  0.988  0.727   1.360   0.174
age70 - 74 years  0.738 15.821   0.047   0.963
age75 - 79 years  0.985  0.711   1.384   0.166
age80 - 84 years  0.974  0.719   1.355   0.175
age85+ years      0.953  0.547   1.744   0.081.
OACCP:After      -0.007  0.004  -1.807   0.071.
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Tobit difference-in-difference on all separations, Obesity, Marginal Effects at Mean

```
                 effect error t.value p.value
(Intercept)      -0.202 5.484  -0.037   0.971
OACCP             0.005 0.002   3.129   0.002**
After            -0.001 0.001  -1.753   0.080.
sexMale          -0.004 0.001  -6.204   0.000***
age15 - 19 years  0.003 7.205   0.000   1.000
age20 - 24 years  0.001 6.397   0.000   1.000
age25 - 29 years  0.985 0.279   3.530   0.000***
age30 - 34 years  0.985 0.486   2.027   0.043*
age35 - 39 years  0.985 0.512   1.923   0.054.
age40 - 44 years  0.986 0.528   1.866   0.062.
age45 - 49 years  0.987 0.796   1.241   0.215
age50 - 54 years  0.989 1.126   0.879   0.379
age55 - 59 years  0.991 1.693   0.585   0.558
age60 - 64 years  0.990 2.682   0.369   0.712
age65 - 69 years  0.987 3.695   0.267   0.789
age70 - 74 years  0.145 5.485   0.026   0.979
age75 - 79 years  0.984 4.434   0.222   0.824
age80 - 84 years  0.984 3.926   0.251   0.802
age85+ years      0.979 4.509   0.217   0.828
OACCP:After      -0.007 0.001  -5.931   0.000***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Tobit difference-in-difference on all separations, Hypertension, Marginal Effects at Mean

	effect	error	t.value	p.value
(Intercept)	-0.917	16.082	-0.057	0.955
OACCP	0.024	0.003	7.422	0.000
After	-0.046	0.002	-19.958	0.000
sexMale	0.001	0.001	0.660	0.509
age15 - 19 years	0.010	20.296	0.001	1.000
age20 - 24 years	0.927	0.131	7.068	0.000
age25 - 29 years	0.013	19.298	0.001	0.999
age30 - 34 years	0.925	0.576	1.606	0.108
age35 - 39 years	0.929	0.199	4.665	0.000
age40 - 44 years	0.932	0.277	3.367	0.001
age45 - 49 years	0.940	0.444	2.120	0.034
age50 - 54 years	0.957	0.644	1.487	0.137
age55 - 59 years	0.974	0.750	1.298	0.194
age60 - 64 years	0.985	0.720	1.369	0.171
age65 - 69 years	0.989	0.657	1.505	0.132
age70 - 74 years	0.774	16.083	0.048	0.962
age75 - 79 years	0.986	0.615	1.603	0.109
age80 - 84 years	0.975	0.630	1.549	0.121
age85+ years	0.954	0.475	2.009	0.045
OACCP:After	-0.027	0.004	-7.532	0.000

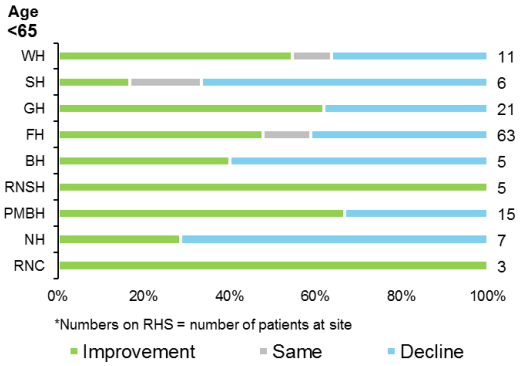
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

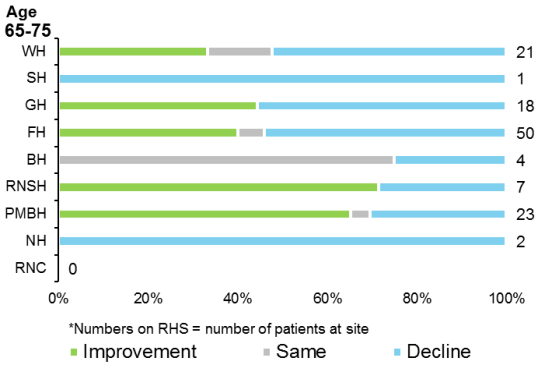
Appendix E: Cohort analysis of clinical outcomes

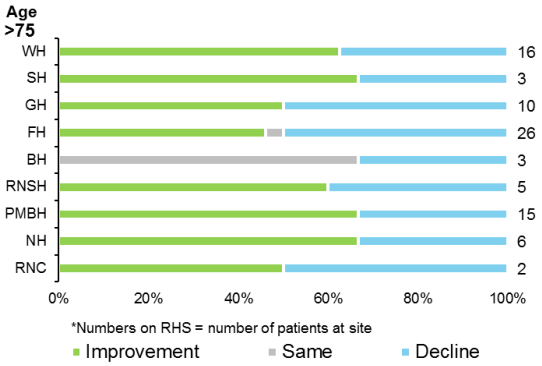
Timed Up-and-Go Test

Patient cohorts: Age

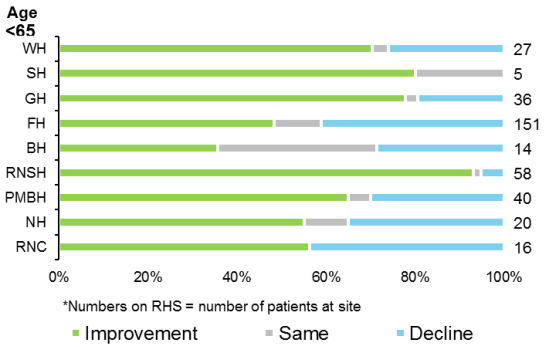
Hip osteoarthritis patients

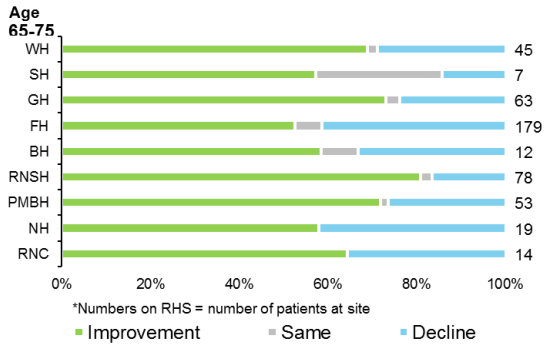


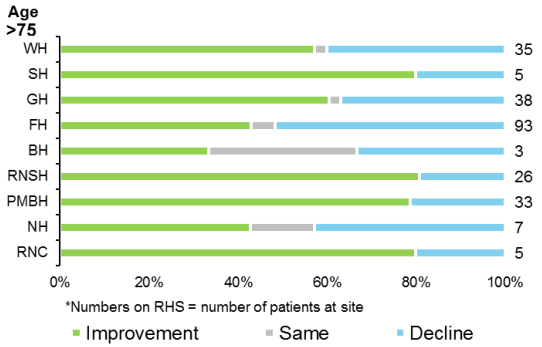




Knee osteoarthritis patients



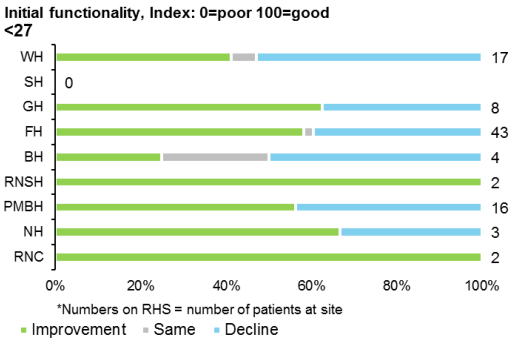


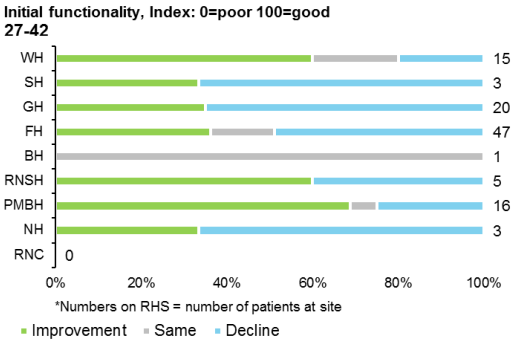


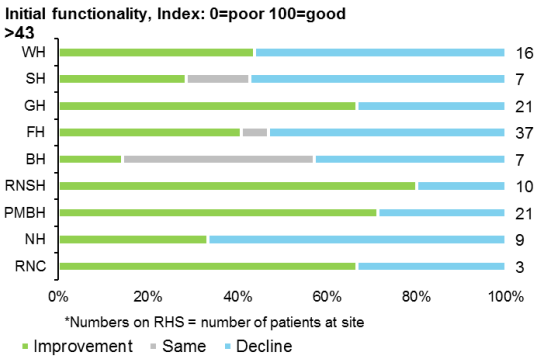
Timed Up-and-Go Test

Patient cohorts: Initial HOOS (Functionality in Daily Living) score

Hip osteoarthritis patients

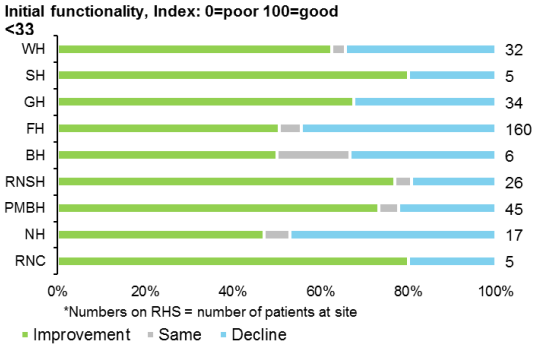


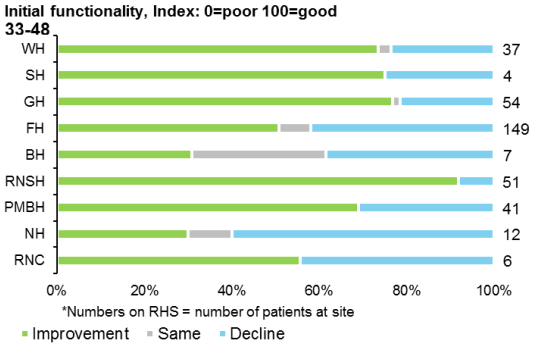


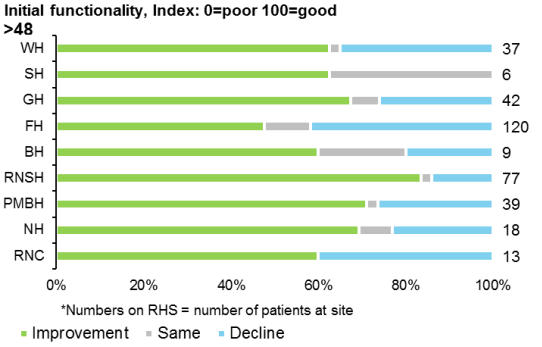


Patient cohorts: Initial KOOS (Functionality in Daily Living) score

Knee osteoarthritis patients



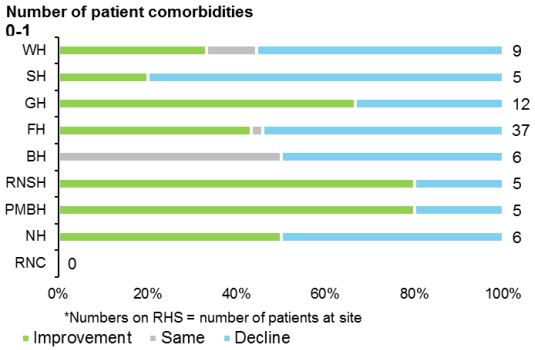


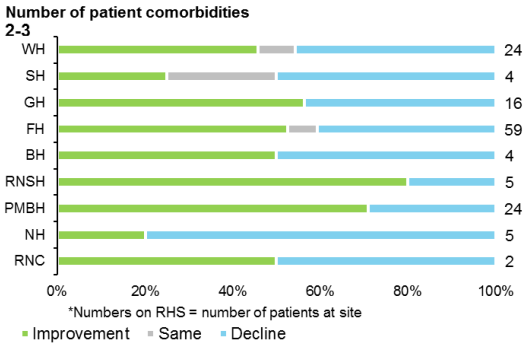


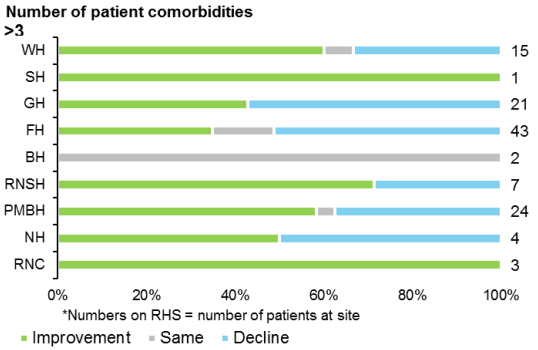
Timed Up-and-Go Test

Patient cohorts: Patient Comorbidities

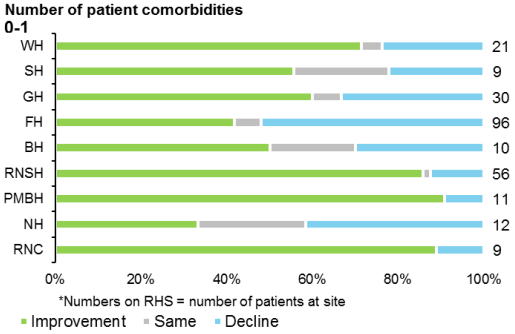
Hip osteoarthritis patients

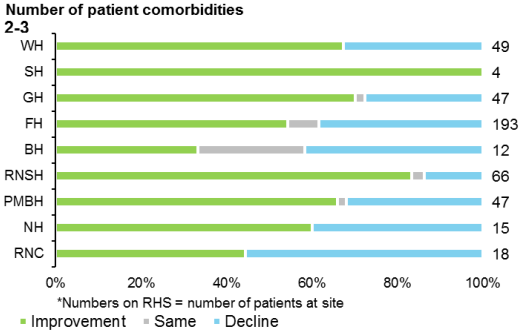


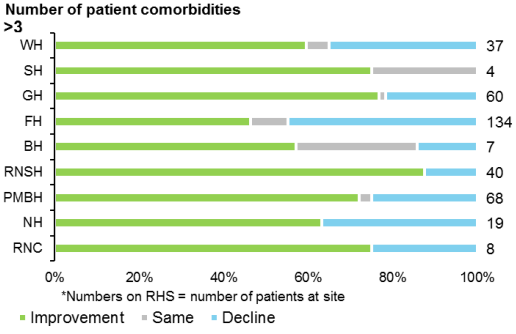




Knee osteoarthritis patients



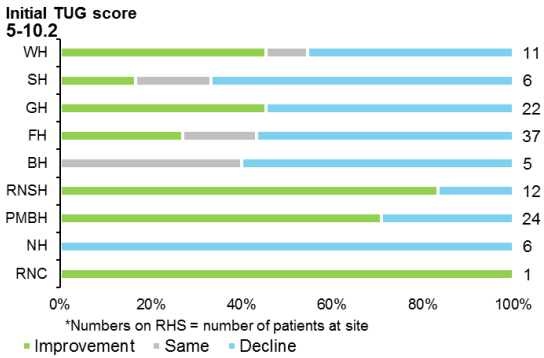


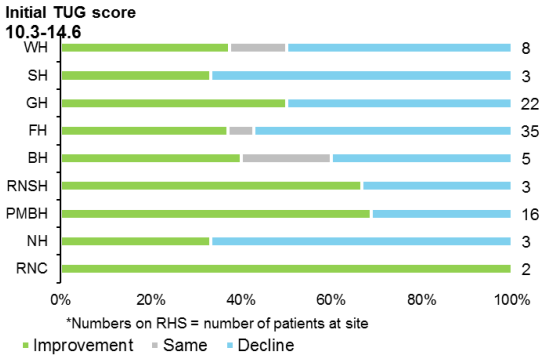


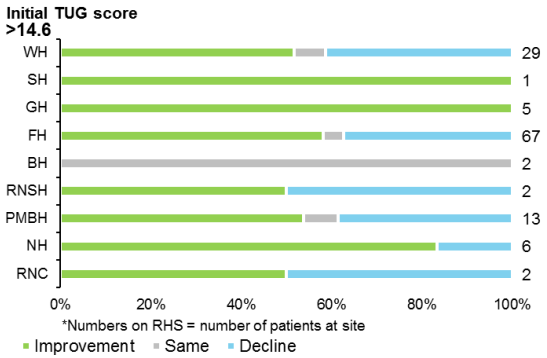
Timed Up-and-Go Test

Patient cohorts: Initial Timed Up-and-Go Test score

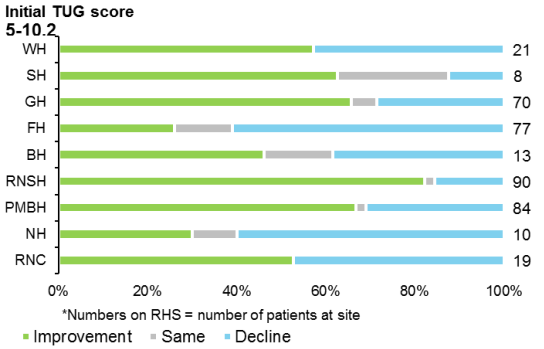
Hip osteoarthritis patients

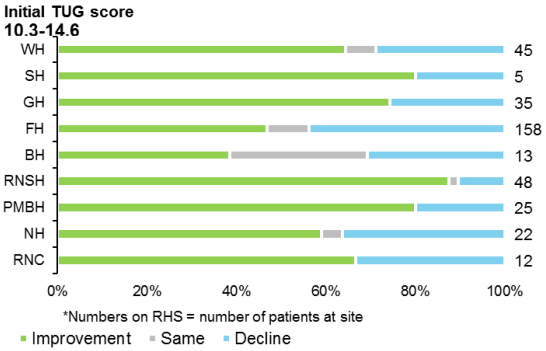


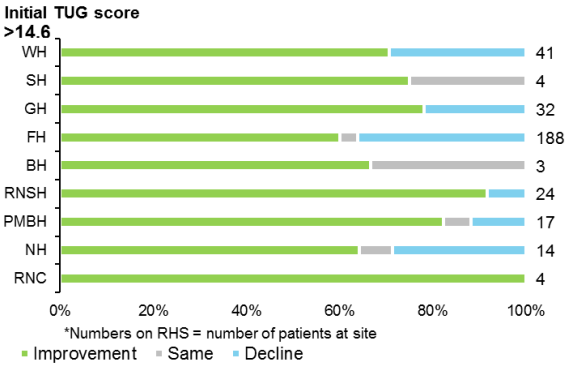




Knee osteoarthritis patients



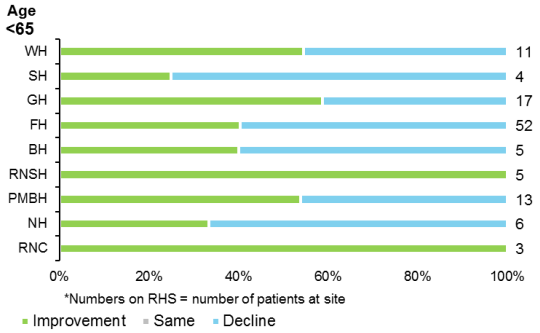


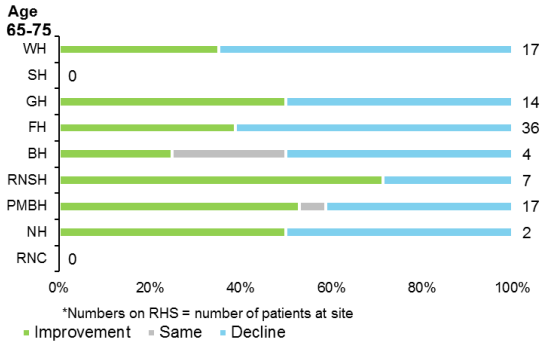


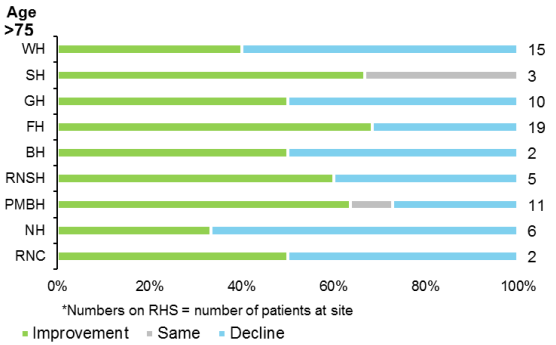
Six Minute Walk Test

Patient cohorts: Age

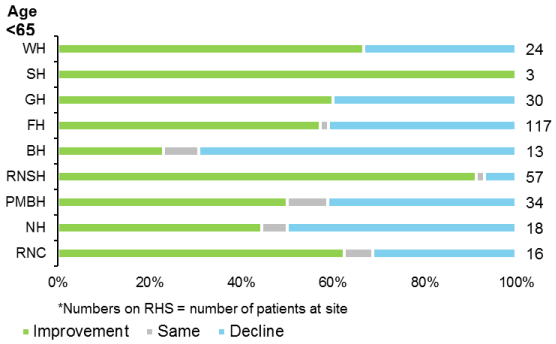
Hip osteoarthritis patients

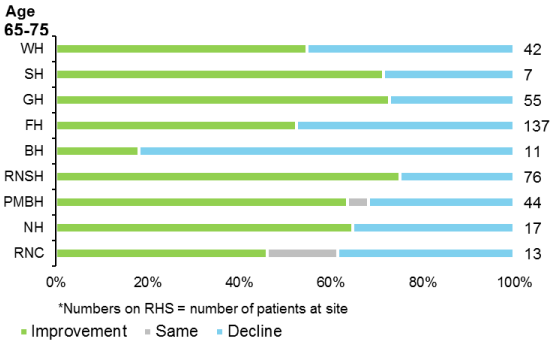


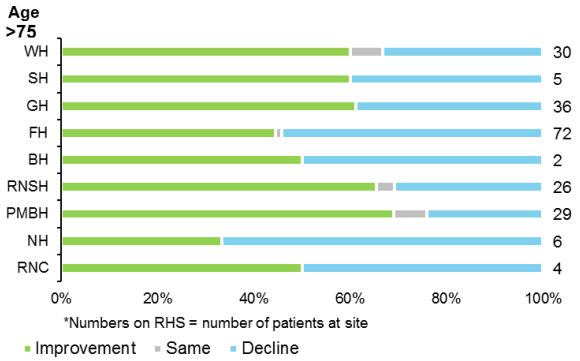




Knee osteoarthritis patients



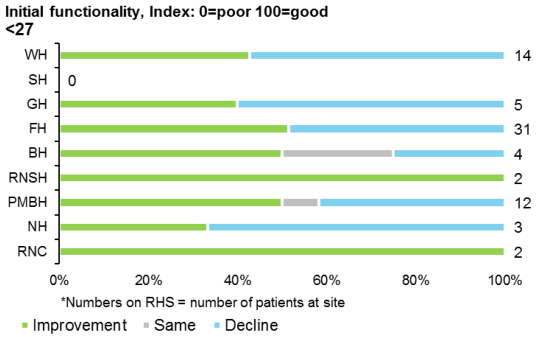


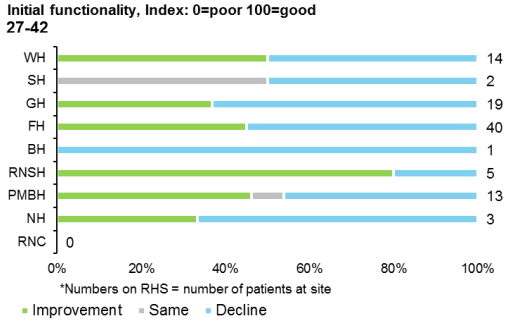


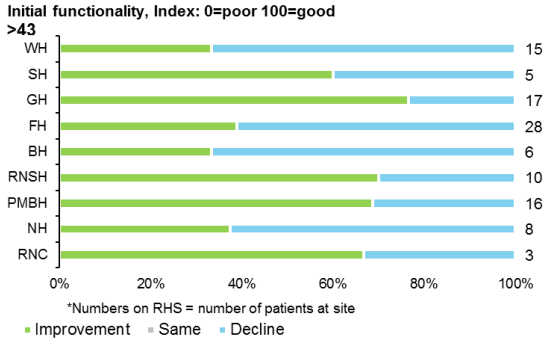
Six Minute Walk Test

Patient cohorts: Initial HOOS (Functionality in Daily Living) score

Hip osteoarthritis patients

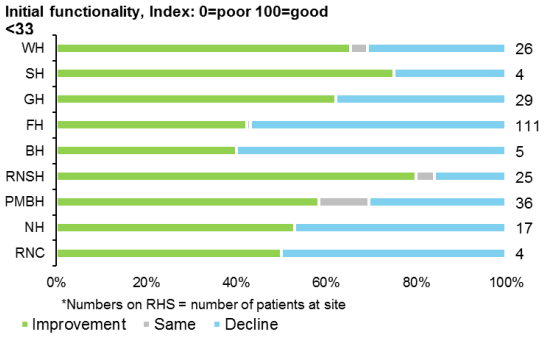


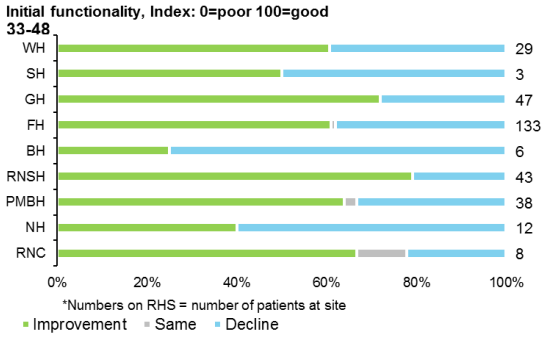


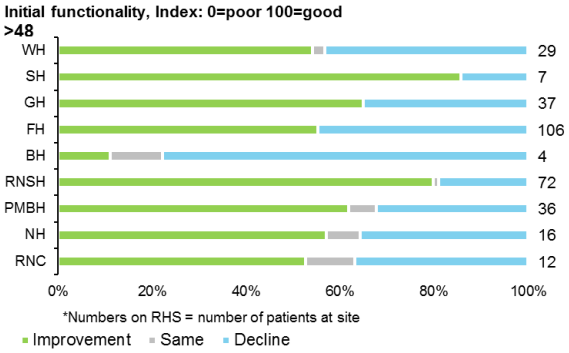


Patient cohorts: Initial KOOS (Functionality in Daily Living) score

Knee osteoarthritis patients



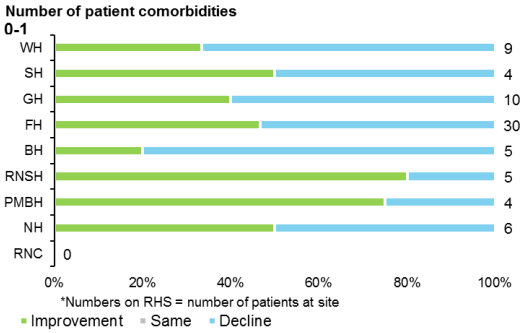


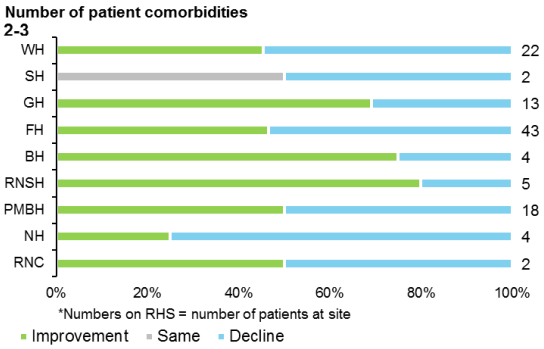


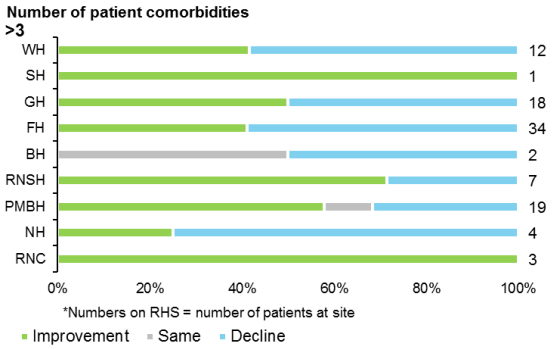
Six Minute Walk Test

Patient cohorts: Patient Comorbidities

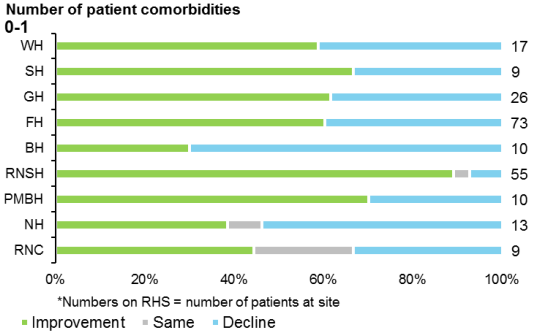
Hip osteoarthritis patients

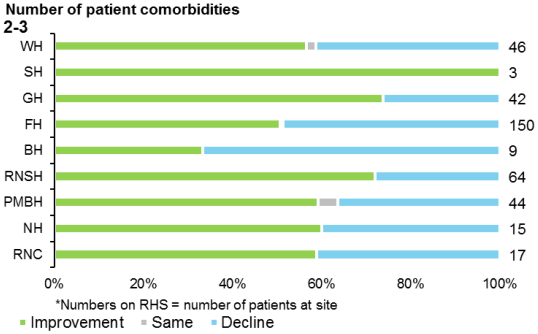


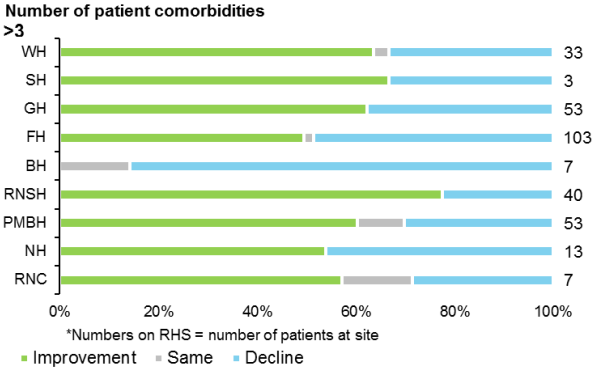




Knee osteoarthritis patients



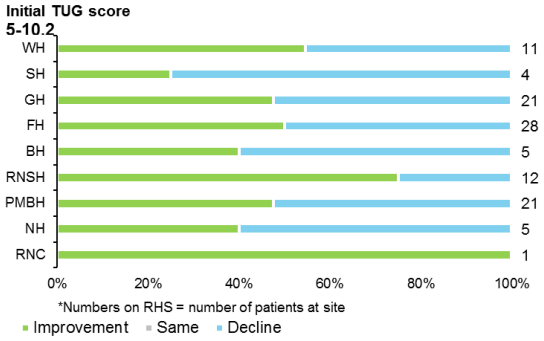


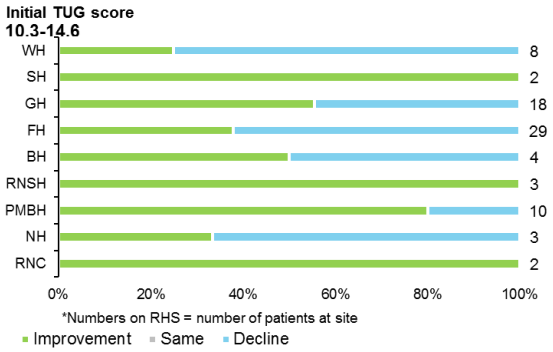


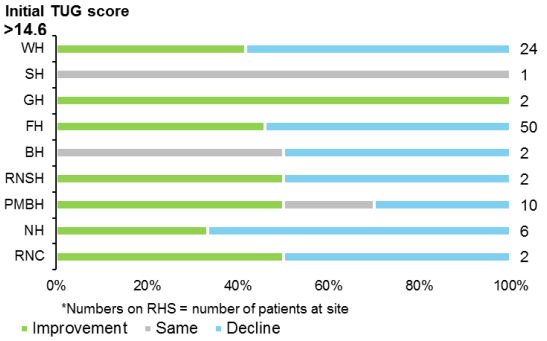
Six Minute Walk Test

Patient cohorts: Initial Timed Up-and-Go Test score

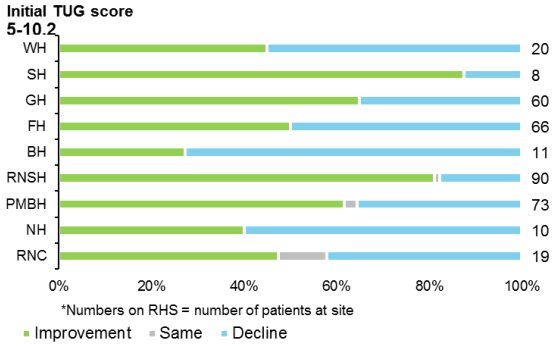
Hip osteoarthritis patients

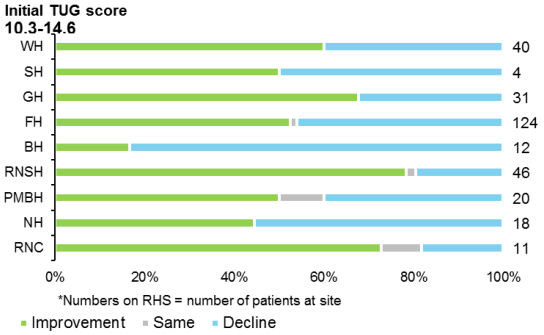


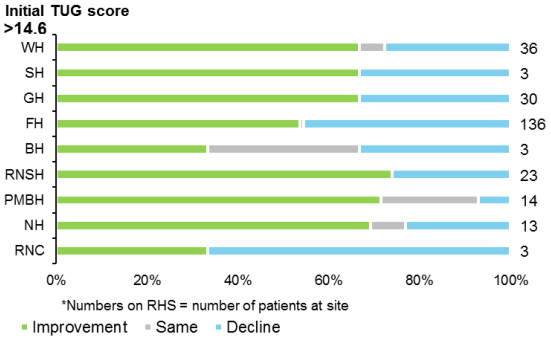




Knee osteoarthritis patients



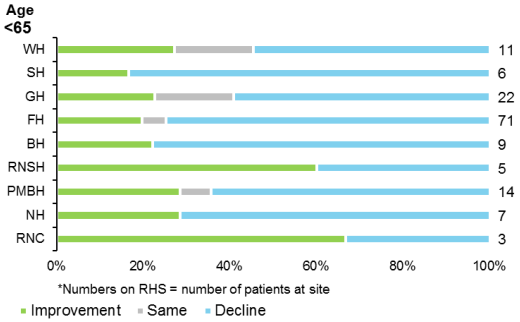


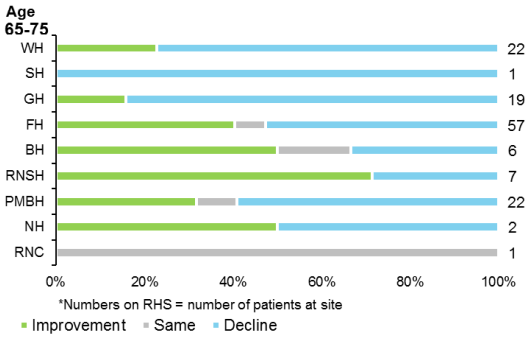


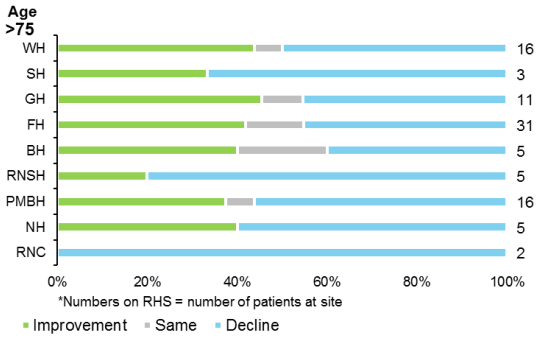
HOOS and KOOS: Pain

Patient cohorts: Age

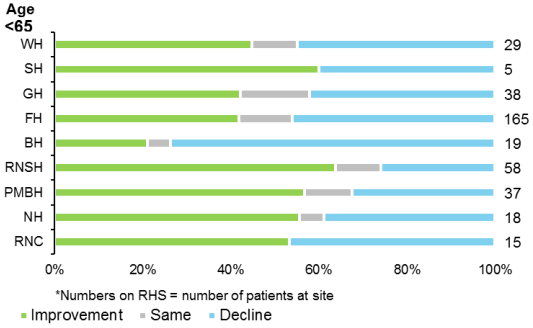
Hip osteoarthritis patients

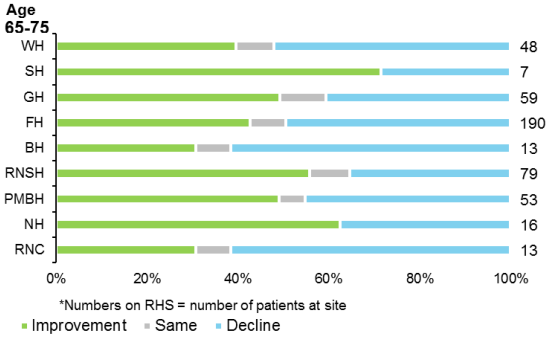


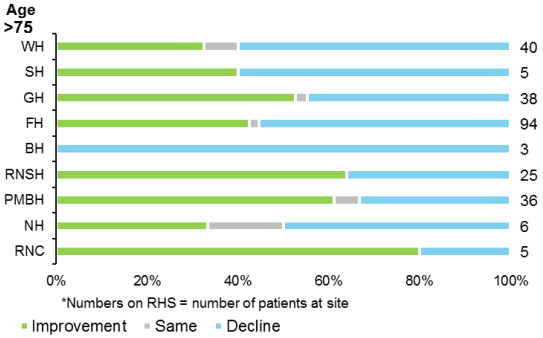




Knee osteoarthritis patients



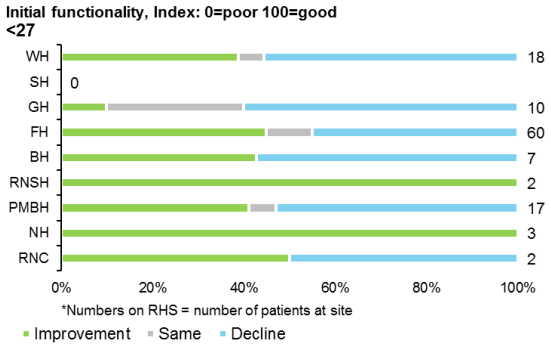


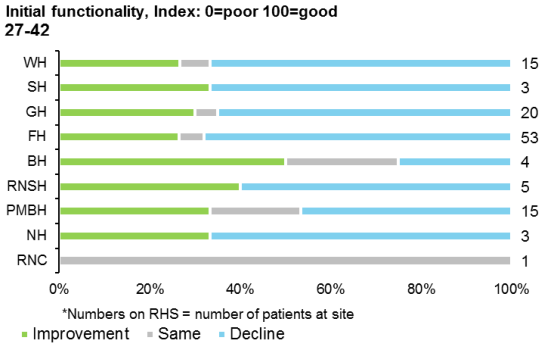


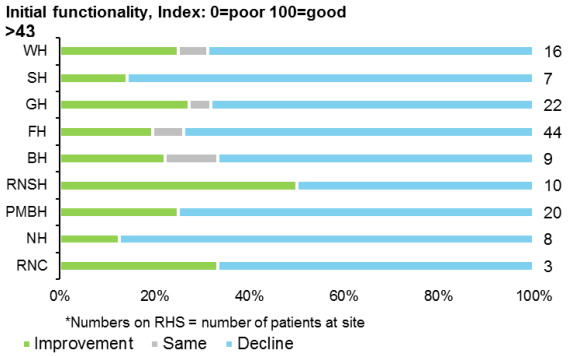
HOOS and KOOS: Pain

Patient cohorts: Initial HOOS (Functionality in Daily Living) score

Hip osteoarthritis patients

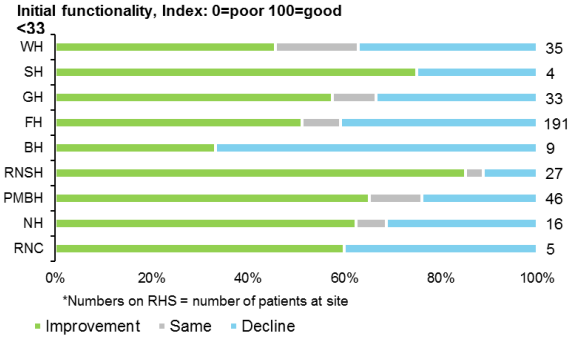


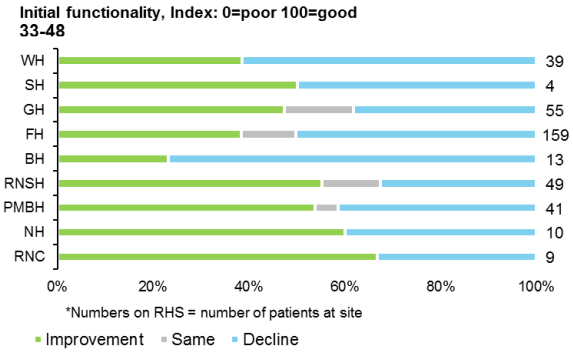


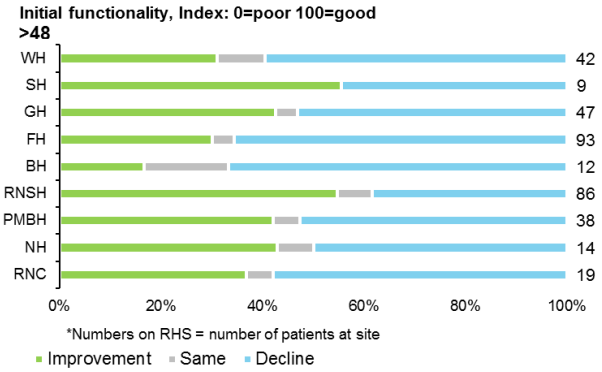


Patient cohorts: Initial KOOS (Functionality in Daily Living) score

Knee osteoarthritis patients



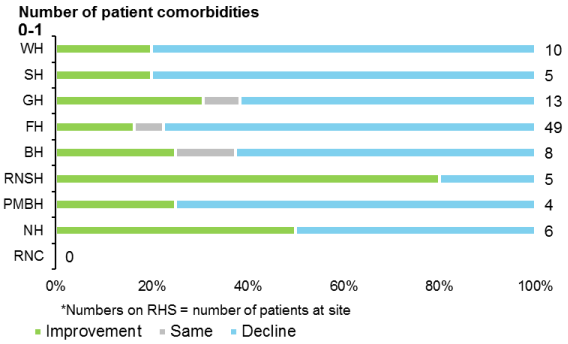


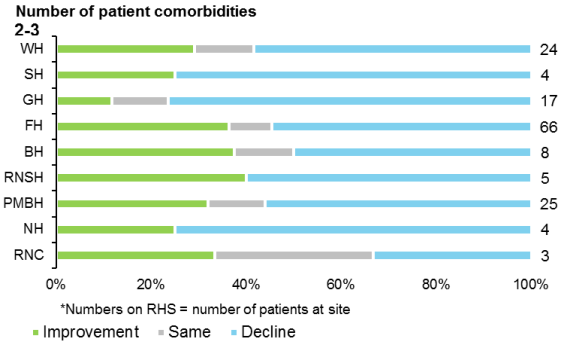


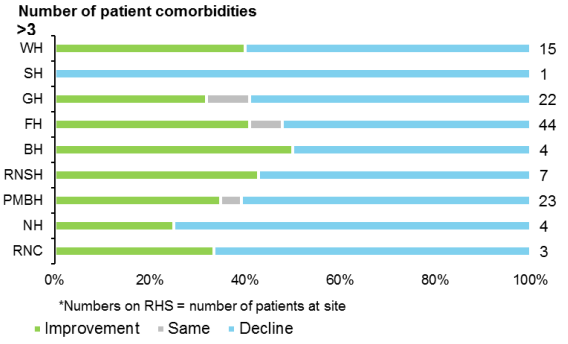
HOOS and KOOS: Pain

Patient cohorts: Patient Comorbidities

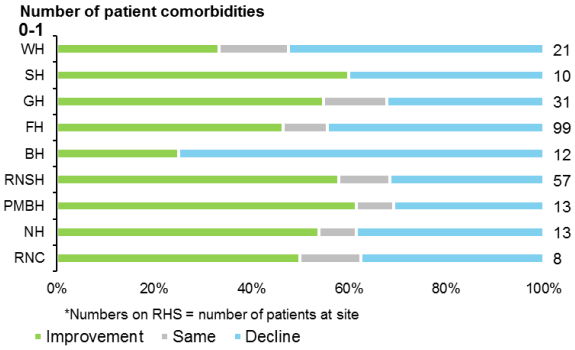
Hip osteoarthritis patients

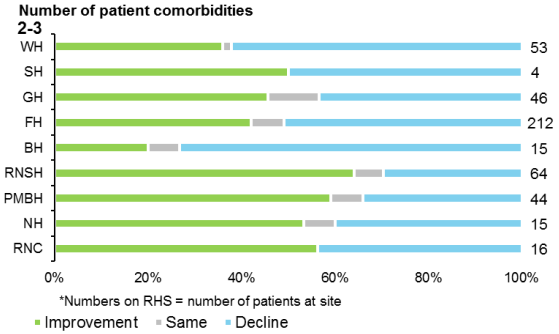


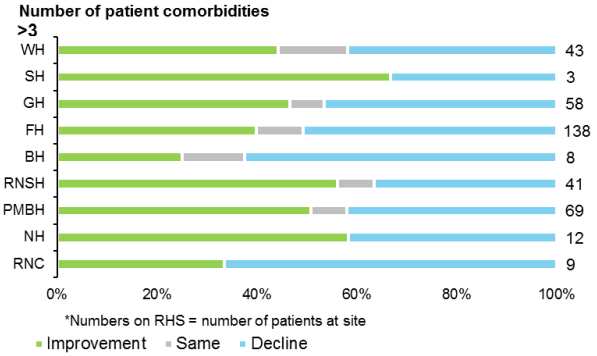




Knee osteoarthritis patients



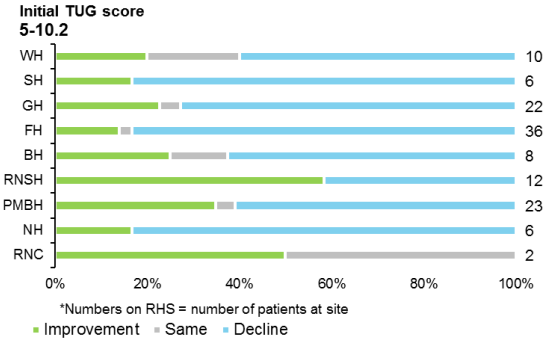


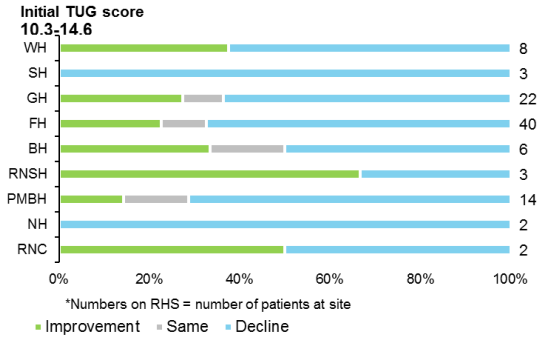


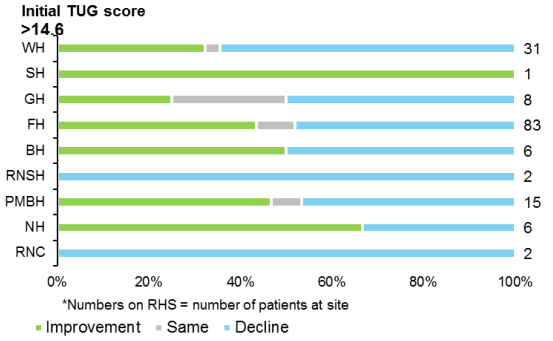
HOOS and KOOS: Pain

Patient cohorts: Initial Timed Up-and-Go Test score

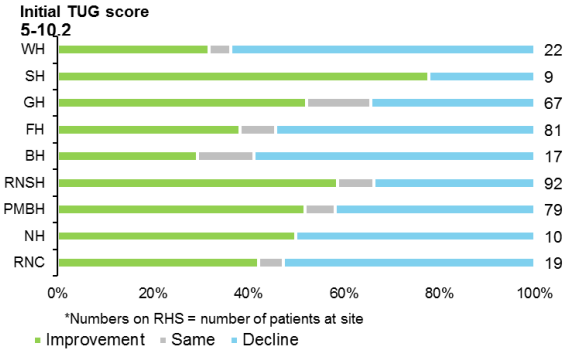
Hip osteoarthritis patients

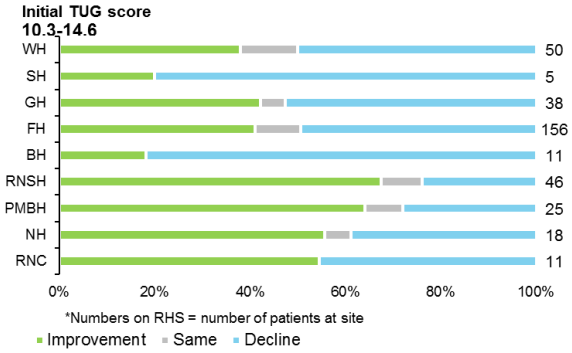


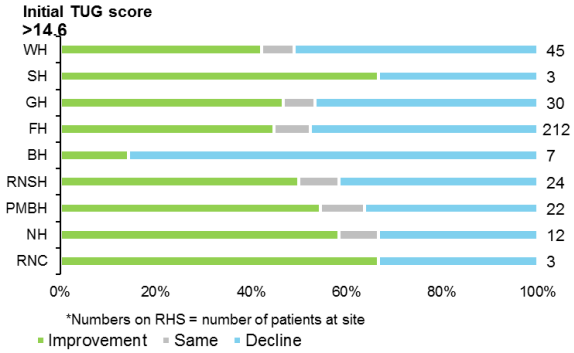




Knee osteoarthritis patients



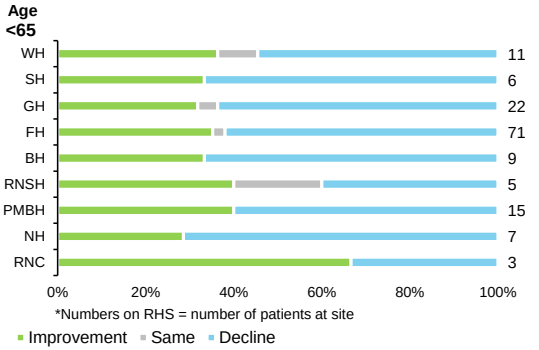


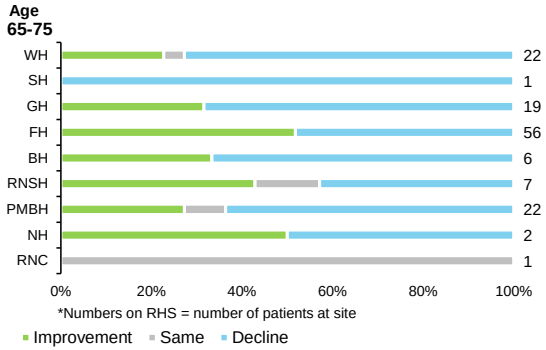


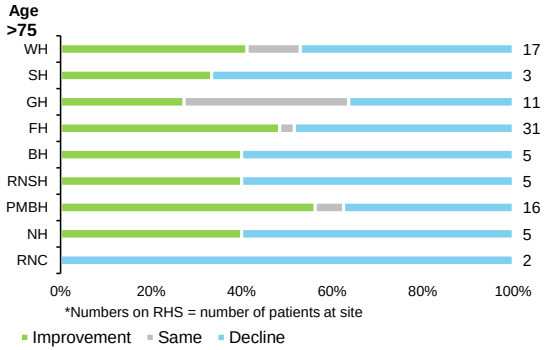
HOOS and KOOS: Functionality in Daily Living (ADL)

Patient cohorts: Age

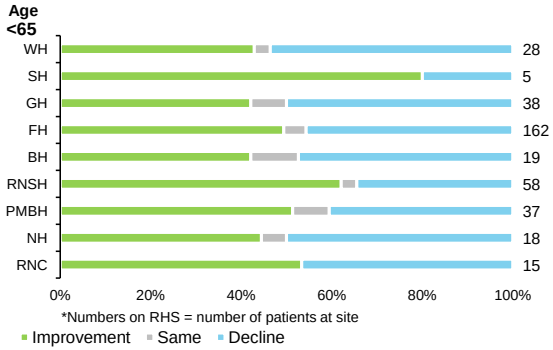
Hip osteoarthritis patients

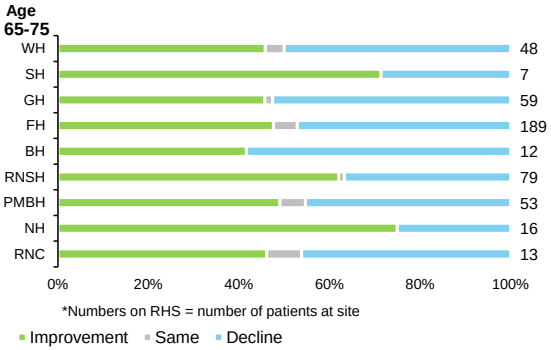


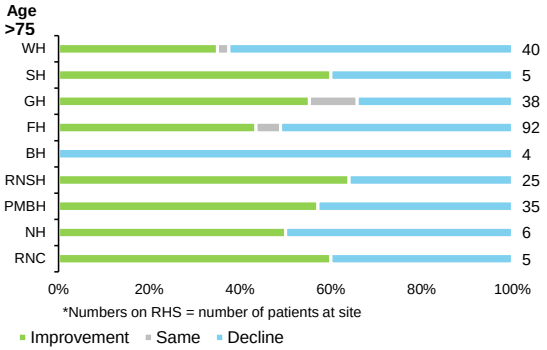




Knee osteoarthritis patients



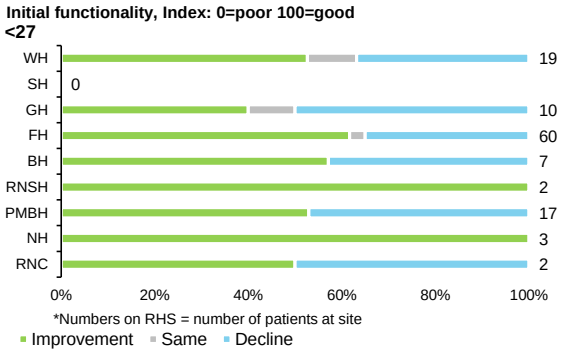


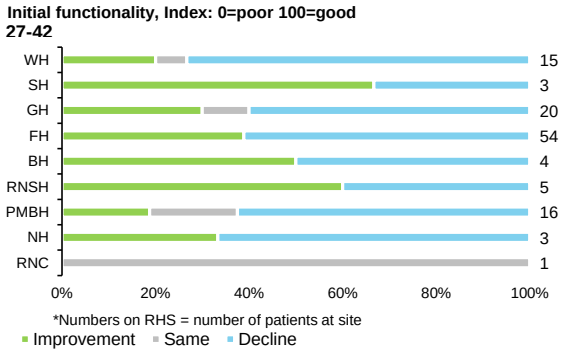


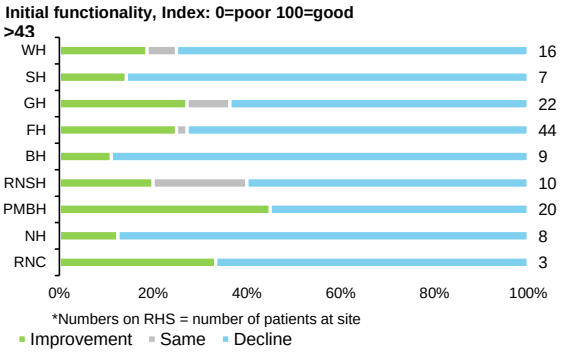
HOOS and KOOS: Functionality in Daily Living (ADL)

Patient cohorts: Initial HOOS (Functionality in Daily Living) score

Hip osteoarthritis patients

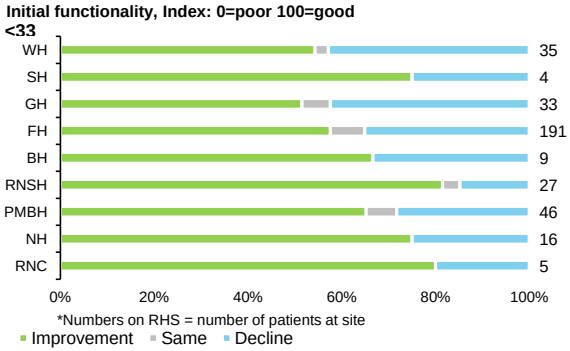


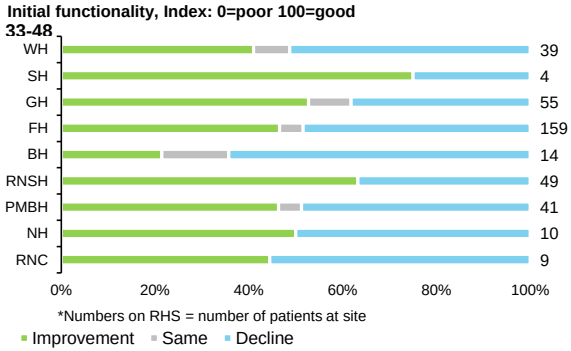


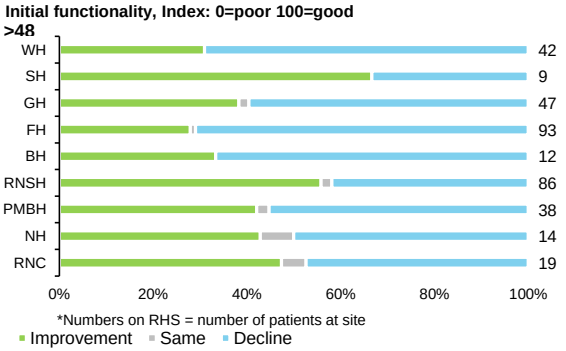


Patient cohorts: Initial KOOS (Functionality in Daily Living) score

Knee osteoarthritis patients



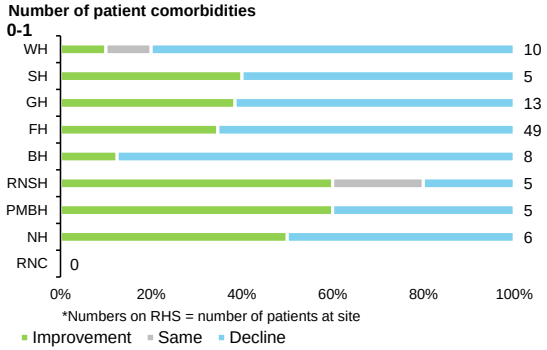


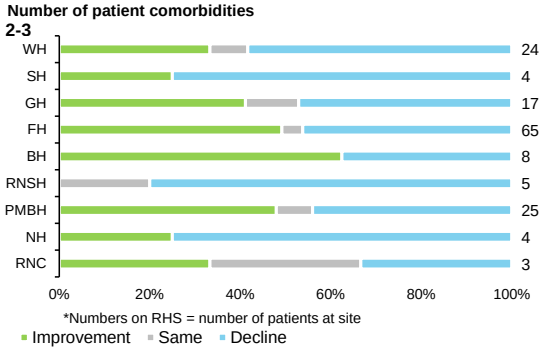


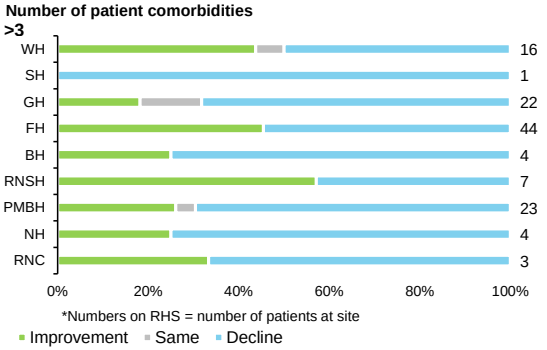
HOOS and KOOS: Functionality in Daily Living (ADL)

Patient cohorts: Patient Comorbidities

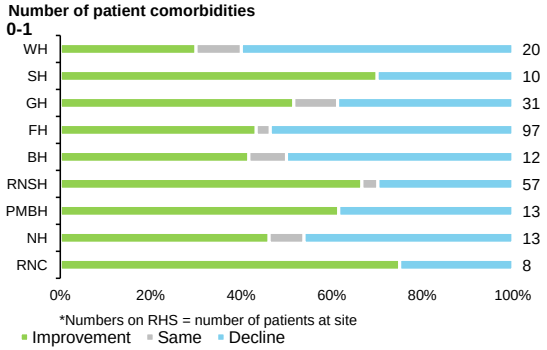
Hip osteoarthritis patients

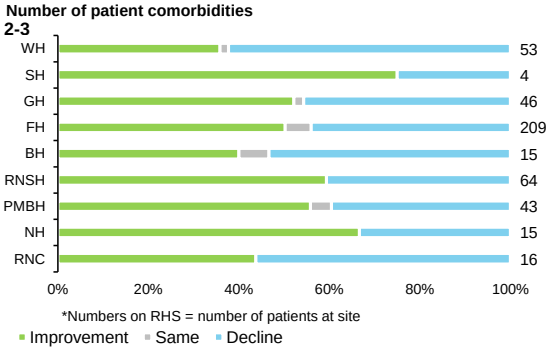


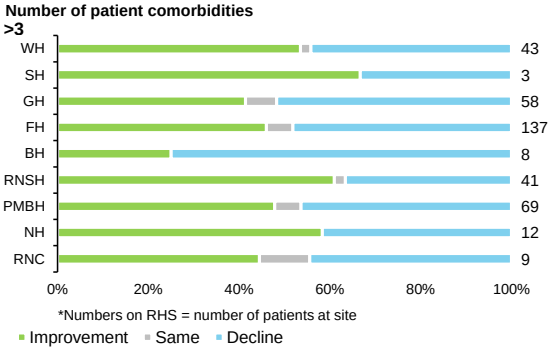




Knee osteoarthritis patients



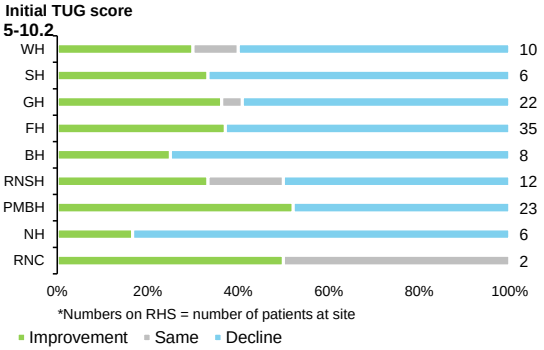


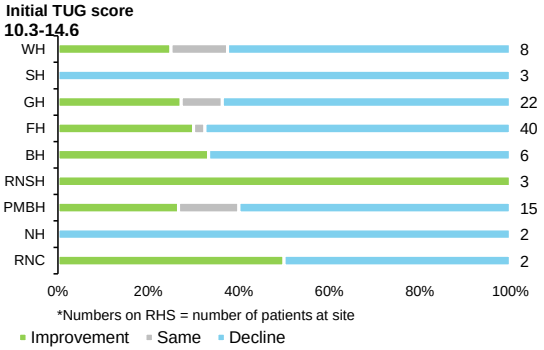


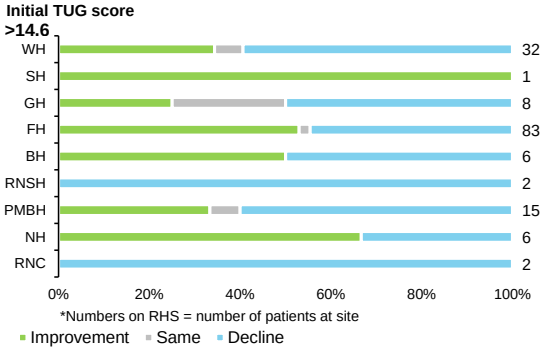
HOOS and KOOS: Functionality in Daily Living (ADL)

Patient cohorts: Initial Timed Up-and-Go Test score

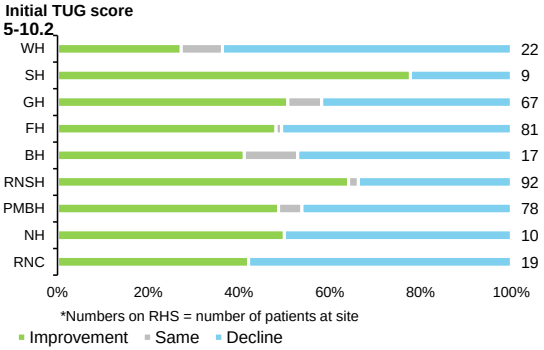
Hip osteoarthritis patients

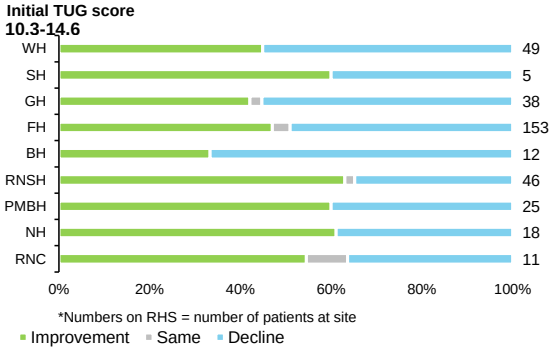


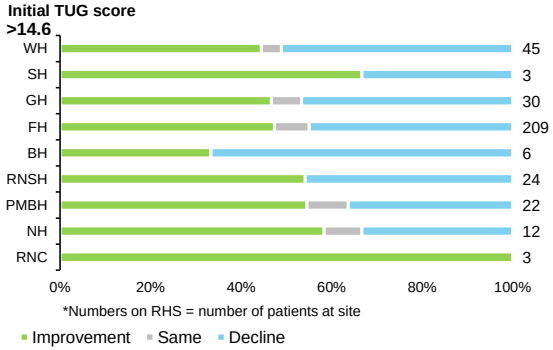




Knee osteoarthritis patients







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