Real-World Evaluation Report for PRO-MAPP: Optimising Preoperative Assessment and Optimisation

Flora Gleave,

Project Manager,

Ashley Aitken,

Senior Programme Manager,

Oxford Academic Health Science Network

5th September 2023

Table of Contents

Table of Figures

1. Summary Overview

PRO-MAPP is a secure cloud-based Software-as-a-Service platform developed by PRO-MAPP Ltd, a spin-out of the University of Oxford. It facilitates engagement between patients and staff to gather, organise, and display data efficiently, and enhances patient/staff interaction.

Undertaken as part of a broader programme of work to evaluate the benefits of four different peri-operative innovations in different healthcare settings across the Thames Valley, a real-world evaluation was conducted at the Nuffield Orthopaedic Centre (NOC), part of Oxford University Hospitals NHS Foundation Trust (OUH).

PRO-MAPP was used as an engagement tool for patients and healthcare staff, providing intelligent decision support to optimise the preoperative assessment (POA) process in the Pre-Assessment Clinic Triage (PACT) pathway. It was used for POA triage and stratification of High-Volume, Low Complexity (HVLC) orthopaedic cases. Additionally, patient optimisation was started early in the clinic pathway, which is an evolution of current practice. This digital transformation of POA workflow allowed a more personalised approach to the individual needs of patients on the hip and knee surgical waiting list.

Patients were registered to the platform when added to the surgical waiting list after an outpatient appointment and were triaged to a face-to-face or telephone POA. The platform identified patients who were medically complex or required a specialist investigation (e.g., ECHO) or review, where a face-to-face POA was booked; otherwise, a telephone POA was scheduled.

The evaluation aimed to collect real-world evidence and insight from the implementation of PRO-MAPP to demonstrate its value in real-world settings for the patients, the system and the NHS workforce. This report presents the real-world evaluation findings conducted from 1st April 2022 to 31st January 2023.

75% of patients added to the hip and knee surgical waiting list who were triaged by PRO-MAPP were suitable for a telephone POA. Moreover, patients who were classified as medically complex and required face-to-face POA and specialist investigations/reviews only needed to make one visit to the hospital for a combined appointment. Findings highlighted that using the PRO-MAPP in the PACT pathway facilitated appropriate triage, early patient optimisation and POA in the clinical pathway, leading to fewer surgery postponements and better use of resources.

Health economic analysis indicated that implementing PRO-MAPP into the clinical pathway for patients on the hip and knee surgical waiting list was cost saving compared with the standard pathway. The PRO-MAPP pathway cost £2,958 per patient compared with the standard pathway, which cost £3,728 per patient, saving £770 per patient.

Based on the data collected during this real-world evaluation, PRO-MAPP has also saved 51,381.6 km of travel due to reduced patient travel for hospital appointments. Considering that the average car in the UK emits 171 grams of CO_2 per km [1], this evaluation has reduced 8.8 tonnes of CO_2 emissions.

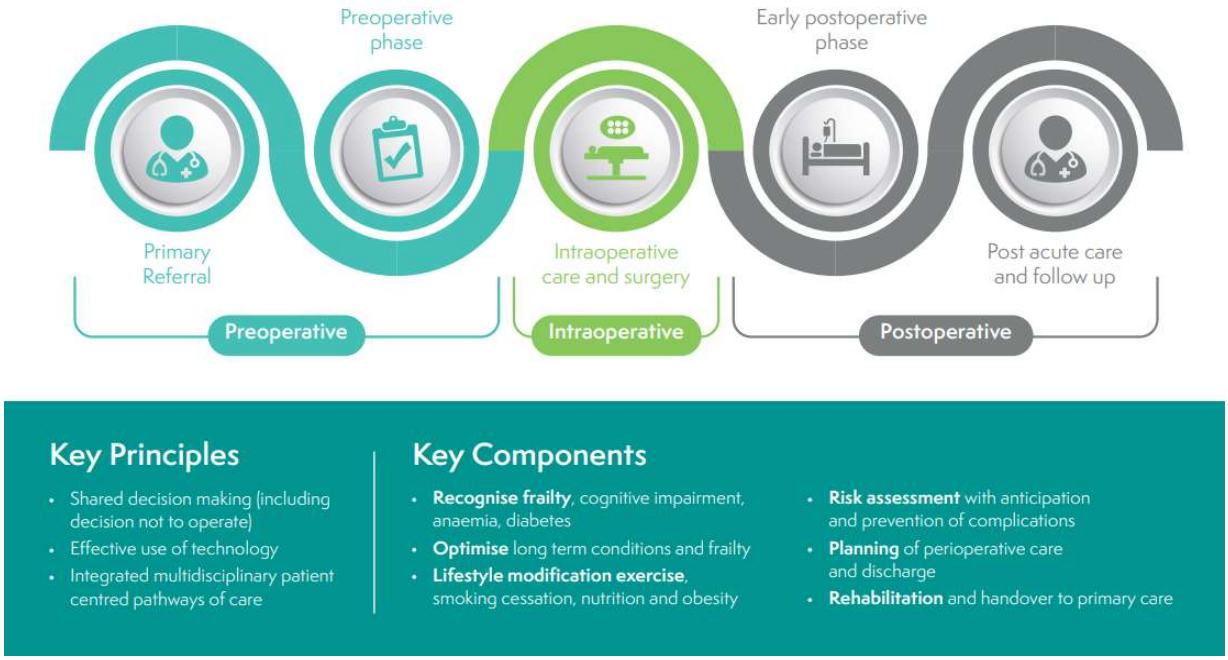
A patient engagement survey provided positive feedback; 100% of patients were very satisfied or satisfied and 92% of patients stated that the questionnaire was easy or very easy to complete.

2. Introduction

In 2021, the NHS England Transformation Directorate launched the Adoption Fund to support innovations that help people to stay or get well at home and current priorities in elective recovery [2]. Eligible innovations had an evidence base in the NHS and the potential of rapid, widespread adoption across the NHS. Adoption funding was successfully obtained through a collaborative bid by the Oxford Academic Health Science Network (Oxford AHSN) and the Buckinghamshire, Oxfordshire and Berkshire West (BOB) Integrated Care System (ICS). The delivery partners were OUH, Royal Berkshire NHS Foundation Trust (RBFT) and Buckinghamshire Healthcare NHS Trust (BHT). The funding received supported real-world evaluations of digitally enabled services that enhance perioperative pathways within the BOB ICS.

Perioperative care is the integrated multidisciplinary care of patients from the moment surgery is contemplated to full recovery. It involves a variety of interventions with integrated pathways crossing primary, social and secondary care and includes components such as shared decision-making, preoperative assessment, help to get ready for surgery through exercise, nutrition, and smoking cessation, discharge planning, multidisciplinary working and follow-up after surgery [3] [4]. Figure 1 provides an overview of the perioperative pathway [3]. The BOB ICS and Oxford AHSN bid focused on supporting the preoperative pathway (preoperative assessment and optimisation).

Figure 1: Perioperative Care Pathway



The Centre for Perioperative Care (CPOC) is an interdisciplinary initiative led by the Royal College of Anaesthetists that aims to promote collaborative efforts across organisations to provide high-quality perioperative care that has benefits for the patients and health service whilst reducing healthcare costs [3] [4]. Research has shown that perioperative care can benefit patients, healthcare providers and the workforce, but the improvements depend on the initiatives evaluated, surgical speciality, and complexity [4]. Table 1 provides an overview of the varied quality and quantity of evidence supporting perioperative care [4].

Table 1: Levels of Evidence for the Different Components of Perioperative Care

The proposed programme of work in the BOB ICS and Oxford AHSN bid aimed to collect more evidence on the research areas highlighted in Table 1. The anticipated impact on outcomes is outlined below and served as the foundation for the programme's metrics and evaluation criteria.

- Cancellation rates
- Complication rates
- Length of stay
- Healthcare costs
- Readmission rates
- Patient satisfaction levels

2.1. Digital Innovation in Perioperative Care Programme

The overarching BOB ICS and Oxford AHSN programme, "Digital Innovation in Perioperative Care Programme", consisted of four technologies supporting different aspects of perioperative care, Table 2. The programme aimed to implement and evaluate four evidence-based digital solutions that could

transform service delivery in perioperative pathways for our partner NHS Trusts within HVLC pathways.

The technologies, which included Concentric, DayToDay, DORA, and PRO-MAPP, were first implemented in Ophthalmology, Trauma and Orthopaedics, and Ear, Nose and Throat (ENT) pathways due to their long waiting lists and referral to treatment times. Furthermore, these specialities were priority areas for the BOB ICS. The Oxford AHSN's role within this consortium was to evaluate the implementation of each technology in the lead NHS Trust to support sustainable pathway redesign. The programme sought to streamline perioperative pathways through perioperative care and enhance patient safety and experience while increasing capacity and reducing the administrative burden on staff.

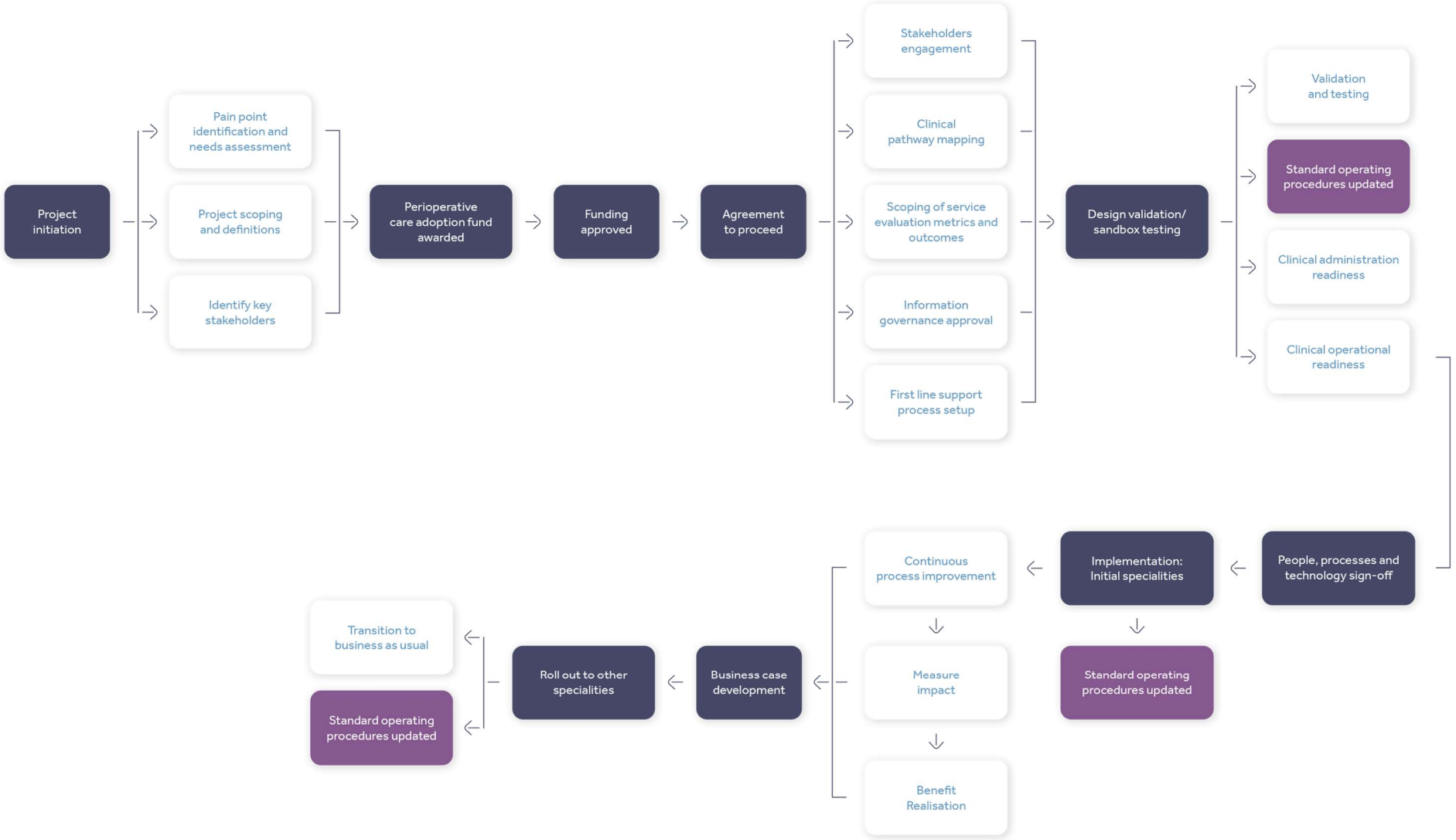
Table 2: Workstream and Technologies in the Digital Innovation in Perioperative Care Programme

Workstream	Aspects of Perioperative Care	The Technologies in the Programme	Specialty and Trust
Workstream 1	Waiting well and pre-habilitation	DORA	Ophthalmology in BHT
		DayToDay	Hip and Knee in RBFT
Workstream 2	Digital Consent and Shared Decision Making	Concentric	Ophthalmology, OUH
Workstream 3	Preoperative assessment	PRO-MAPP	Hip and knee at OUH
Workstream 4	Digital Patient Reported Outcome Measures (PROMs).	PRO-MAPP	Hip and knee at OUH

Ufonia, Concentric Health and PRO-MAPP Ltd developed DORA, Concentric and PRO-MAPP respectively. DayToDay is from Babylon.

This report outlines the findings from the real-world evaluation of PRO-MAPP, including health economic analysis to support business case development and feedback from patients and the workforce. The implementation of PRO-MAPP focused on delivering against clinical and system needs and aspirations. Figure 2 shows an overview of PRO-MAPP's real-world evaluation and implementation process. The real-world evaluation outcomes have served as a decision support tool for the continued use of PRO-MAPP at the NOC and spread and adoption into other specialities at OUH. An implementation support pack designed to help other health and care stakeholders implement PRO-MAPP has been developed and is available on request.

Figure 2: Overview of the Real-World Evaluation and Implementation Process



3. Scope of the Real-World Evaluation

3.1. The Challenge: Clinical Need

The NOC is a specialist musculoskeletal hospital providing a comprehensive range of orthopaedic services, from HVLC joint replacement procedures to quaternary bone infection services in the internationally renowned Bone Infection Unit. Accredited by the Healthcare Information and Management Systems Society, it has achieved Stage 6 accreditation on the Electronic Medical Record Adoption Model for its use of technology to improve patient care.

Before the COVID-19 pandemic, the NOC performed over 1500 hip and knee replacements annually. The NOC encountered a challenge in increasing its elective capacity and reducing the unprecedented backlog post-covid due to the constraints within the POA process. Insufficient patients were 'fit for surgery' to populate theatre lists. Inefficiencies included multiple face-to-face patient visits to the POA clinic before being declared fit for surgery without the option for a personalised patient condition service. Another limitation in the current approach was the challenge of allocating the appropriate level of staff resource/grade to each patient, with no differentiation between high and low complexity cases. Furthermore, all POA appointments were conducted face-to-face approximately 4-6 weeks before the anticipated surgery. However, the pandemic highlighted the effectiveness of virtual assessments as an alternative to in-person appointments. This approach proved particularly useful for tertiary and quaternary referrals, which allowed patients outside the region to access specialised services easily.

The key aspirations at the NOC were to:

- prioritise face-to-face assessment for patients with conditions that need it.
- start preoperative patient optimisation earlier in the clinical pathway.
- reduce patient cancellations caused by delayed investigations in the clinical pathway.
- have better utilisation of theatre capacity.
- increase the pool of patients declared 'fit for surgery' to assist elective recovery.
- improve compliance with personalised assessment planning.
- reduce the administrative burden on specialist preoperative nursing staff.
- reduce outpatient footfall and unnecessary patient travel.

The NOC's health professionals and management team identified an unmet need for the digital collection of health screening data completed by patients when listed for surgery. Following National Institute for Clinical Excellence (NICE) guidance NG45 [5] and some elements of CPOC guidelines [3], they wanted to identify required preoperative investigations intelligently. There was a need for

patients requiring investigation or treatment before surgery to be identified early in the patient pathway to prevent subsequent surgery postponement. Furthermore, there was a desire to minimise the number of patients visiting the outpatient department and avoid unnecessary travel. It was felt that incorporating virtual preoperative assessments would help achieve this objective, making the preoperative assessment process more efficient and convenient.

3.2. A Solution: Digital Innovation

PRO-MAPP is a secure cloud-based Software-as-a-Service platform developed by PRO-MAPP Ltd, a spin-out of the University of Oxford. It facilitates engagement between patients and staff, regardless of the devices (tablets, phones or desktops) used. It was developed by collaborating with experienced surgeons, innovative software designers, and clinical academics to create a patient-centred and pathway agnostic platform. PRO-MAPP does not make patient care decisions automatically. Its primary function is to efficiently gather, organise, and display data to enhance the interaction between patients and staff. PRO-MAPP also records PROMs, National Joint Registry Consent Digital and has digital consent capability. It is accredited to ISO27001, Cyber Essentials Plus, and complies with Digital Technology Assessment Criteria for Health and Social Care.

The platform supported POA triage by gathering health information from the patient after an outpatient appointment. It then uses that information to assist with the patient workflow and identify required preoperative investigations as per NICE NG45 and CPOC guidelines. Through its highly tailorable interfaces, PRO-MAPP drives efficiencies by automatically collecting, analysing, and presenting data collected from patients to staff. Several iterations were made throughout the project to enhance capabilities, usability, and efficiency. The digitalisation of POA workflow enables a more personalised approach to the individual needs of hip and knee surgical waiting list patients.

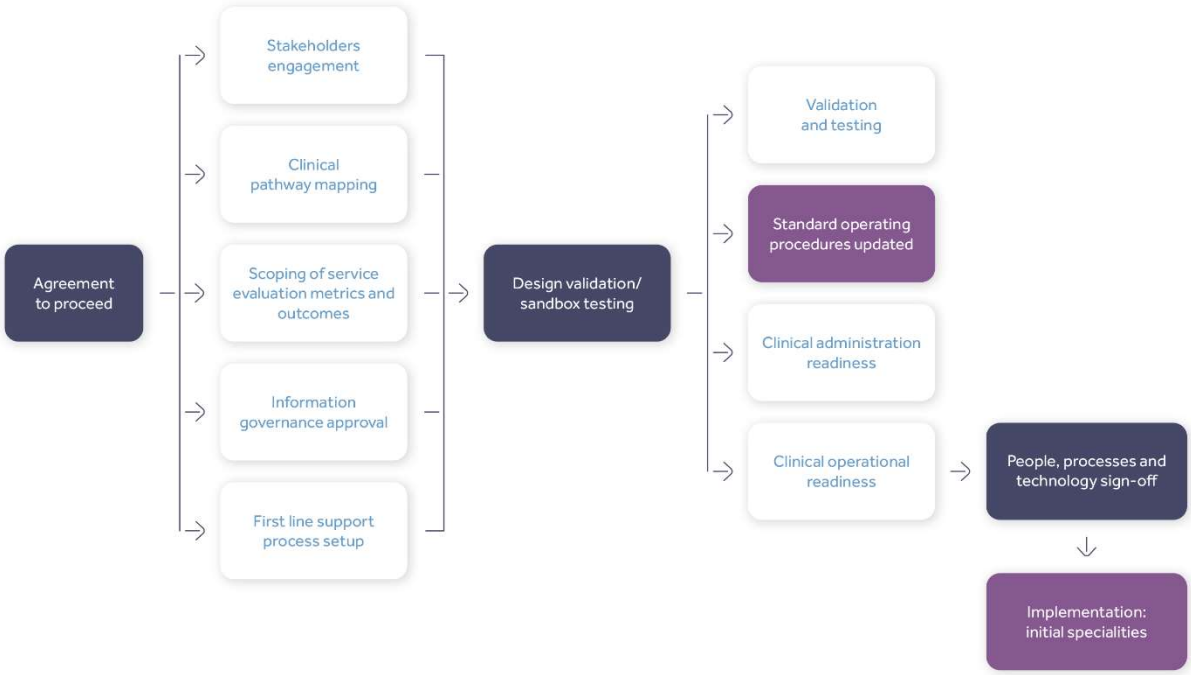
3.3. Aim of the Real-World Evaluation

The NOC's team of healthcare professionals, with support from Oxford AHSN, conducted a real-world evaluation using PRO-MAPP to stratify patients who were scheduled for surgery, based on their level of need. The evaluation focused on assessing the implementation process and the impact of using PRO-MAPP for the POA triage of hip and knee surgery cases. The goal was to gather real-world evidence and insight from the implementation of PRO-MAPP to demonstrate its value in real-use settings. The primary objectives of this real-world evaluation were to produce a health economic evaluation report to facilitate decision-making for ongoing use and to gather information and evidence to support adoption and spread in line with NHS needs.

4. Methodology

Oxford AHSN evaluated the implementation of PRO-MAPP at the NOC to facilitate sustainable pathway redesign and closely collaborated with the service manager and the clinical champion to offer project management support during the implementation process. Figure 3 provides an overview of the implementation process for PRO-MAPP. The project manager supported planning, delivery, and stakeholder relationships to achieve the project's aims. Oxford AHSN also managed risk and issue management, tackled barriers to implementation, supported procurement activities and provided progress reports to stakeholders including NHS England and BOB ICS.

Figure 3: Overview of the Implementation Process for PRO-MAPP



4.1. Stakeholder Engagement

The implementation process of PRO-MAPP was initiated by conducting a stakeholder analysis to identify the individuals or groups impacted by it. The stakeholder analysis was done with multiple stakeholders and allowed them to understand their needs, interests, and level of influence in the project. It was crucial to engage all stakeholders early and develop a communication strategy that aligned the benefits of PRO-MAPP with the relevant stakeholders. Key stakeholders included, but are not limited to, medical directors, clinical directors, the digital team, preoperative nurses, anaesthetic consultants, the pre-assessment clinical leads, and preoperative administrators. All these functions were engaged and involved in designing the new pathway. Identifying the stakeholders needed for

procurement processes, integration, information governance activities and the utilisation of PRO-MAPP was also essential.

Staff training took on average 15 minutes and was delivered in one-to-one or group settings. The company included and conducted the training as part of PRO-MAPP's annual payment/cost. The platform had a user-friendly interface and clear instructions, making it intuitive and easy to use. Additionally, a train-the-trainer option was available.

4.2. Proposed Clinical Pathway: Preoperative Assessment Clinic Triage (PACT) Pathway.

The patient population for this real-world evaluation was patients on the hip and knee surgical waiting list at the NOC. PRO-MAPP served as a tool for engaging patients and healthcare staff, offering intelligent decision-making assistance to enhance the process of POA in the PACT pathway. PRO-MAPP also collects PROMS and National Joint Registry Consent digitally where appropriate. Figure 4 shows the PACT pathway and is also outlined below:

1. Following an outpatient appointment, if the decision was made to add a patient to the surgical waiting list, they were invited to attend PACT on the same day and registered onto PRO-MAPP.
2. Patients completed a health screening and occupational therapy questionnaire on the platform. This helped gather information on their medical history, medications (anaesthetic triage), social situations (occupational therapy triage), and frailty (ortho-geriatrician triage). If patients faced difficulty using the iPad, clinic staff were available to assist them.
3. PRO-MAPP identified which perioperative tests were required for the patients.
4. The patient-specific investigations were conducted before the patients left the clinic.
5. PRO-MAPP assigned patients to a virtual (for non-complex patients) or an in-person POA (for complex patients) based on their results from the questionnaires and patient-specific investigations.

   <u>Non-complex patients:</u>

   a. A telephone POA was scheduled and confirmed before patients left the clinic.
   b. At the POA appointment, a specialist preoperative assessment nurse reviewed the patient history and results of investigations on the platform to determine whether a patient was fit for surgery or required further assessment.

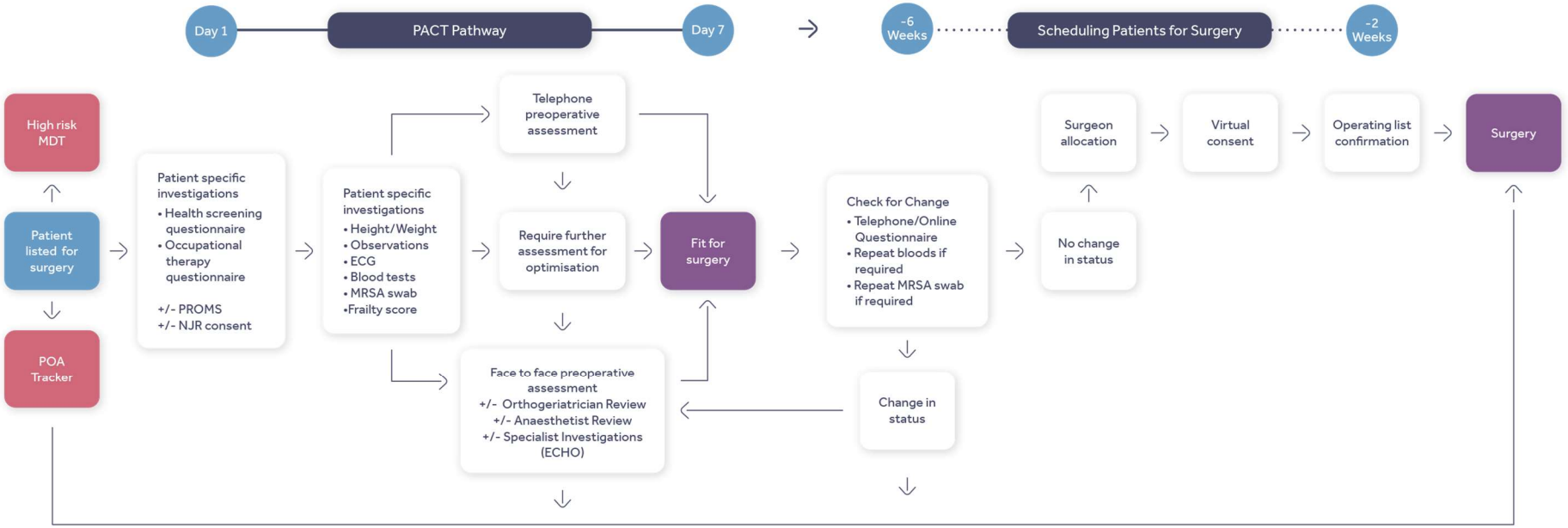
   <u>Complex patients:</u>

   a. Patients who required further assessment, such as preoperative ortho-geriatrician or anaesthetist assessment and/or specialist investigations (e.g., ECHO), had combined face-to-face POA appointments.

b. Patient optimisation started early in the clinical pathway. This reduces the subsequent postponement of surgery and facilitates better utilisation of theatre capacity.

6. Once a patient was declared fit for surgery following a telephone or a face-to-face POA, the scheduling of the patient for surgery and subsequent activities (such as Check for Change) remained unchanged.
7. Data was uploaded to the Electronic Patient Record.

Figure 4: Patient Pathway Through Preoperative Assessment Clinic Triage (PACT)



4.3. Scoping of Real-World Evaluation Metrics and Outcomes

Once the patient population for the evaluation was determined and the clinical pathways were mapped out, the focus shifted to identifying which evaluation metrics should be collected and from where. Different stakeholders had varying needs regarding metrics and outcomes, so ensuring that the data collected aligned with all the different outputs of interest was essential. Measuring the appropriate outcomes was at the heart of the real-world evaluation and getting this right from the start was important. Moreover, anticipating the expected benefits allowed them to determine which metrics to collect to demonstrate the impact of PRO-MAPP. They wanted to collect data that would answer vital questions such as the usability and accessibility of PRO-MAPP from a patient's perspective, the impact on workflow and workforce, training and implementation considerations from a workforce's perspective and cost savings and increased efficiencies from a payer's perspective. York Health Economics Consortium (YHEC) was commissioned to conduct the health economic evaluation. They were involved early to help decide on the metrics to collect to prove the value of PRO-MAPP.

4.4. Evaluation Approach and Methods

The evaluation approach for the overall programme or work was "one pathway/speciality: one technology". This approach enabled the collection of 'clean' data that could be attributed to a single intervention and not influenced by external factors. In collaboration with delivery partners, it was agreed to evaluate the impact of PRO-MAPP in the hip and knee pathway at the NOC. Trauma and Orthopaedics is one of the priority specialties for the BOB ICS and one of the healthcare system's pressure points due to the long waiting list and referral to treatment timeline. A mixed methods analysis combining qualitative and quantitative metrics was used to understand the impact of PRO-MAPP. The Oxford AHSN team led this analysis.

YHEC performed a rapid care pathway analysis to assess the potential impact of introducing PRO-MAPP into perioperative care pathways. This analysis focused on the costs and resources required for patients in the PRO-MAPP and the standard pathways. The model did not include patient outcomes as there are other factors involved in the patient outcomes other than PRO-MAPP. Furthermore, it was challenging to quantify the impact of PRO-MAPP on the patients' outcomes within the short timescales of this evaluation and the data available. The health economic analysis results are outlined in Section 5 [6]. A decision tree model was developed and consisted of two pathways:

I. PRO-MAPP pathway: Patients complete questionnaires on PRO-MAPP and are stratified into face-to-face or telephone POA appointments.
II. Standard care pathway: Patients have a face-to-face POA appointment.

The following quantitative metrics and model input form the basis of the evaluation:

- Proportion of patients recruited who used PRO-MAPP.
- Proportion of patients recruited who used PRO-MAPP and were classified as non-complex.
- Total number of perioperative tests administered to patients.
- Total number of perioperative tests repeated more than once across all patients.
- Total number of POA appointments across all patients.
- Length of stay post-surgery.
- Proportion of surgery cancelled across all patients.
- Proportion of readmissions within 30 days for problems related to the surgery.

The PRO-MAPP and the standard pathways used a hypothetical cohort of 1,000 patients based on real-world evidence collected. The evaluation ran between 1st April 2022 to 31st January 2023 and baseline data was provided from 1st November 2021 to 31st March 2022. For the latter, patients would have gone through the standard pathway; thus, they had a face-to-face POA appointment only. During this real-world evaluation, 734 patients were triaged by PRO-MAPP.

To gather valuable input from staff regarding the implementation of PRO-MAPP, a series of workforce evaluations were carried out both before and during the real-world evaluation. These evaluations were conducted to gain insights into the opinions and perspectives of staff members, thereby facilitating a more informed decision-making process. Through this approach, valuable feedback was obtained, helping to ensure that the implementation of PRO-MAPP was as effective and efficient as possible. The results of staff engagement are in section 6. Additionally, a patient survey was conducted to determine their satisfaction with the service, identify improvement areas and address them during the implementation process; results are detailed in section 7.

4.5. Information Governance

After agreeing upon the metrics and outcomes to be collected, the attention shifted towards information governance. Information governance documentation was completed and approved in line with the Trust policy.

4.6. People, Process and Technology sign-off.

The final milestone to be achieved before the implementation of PRO-MAPP was “the people, process and technology sign-off”. Considering these aspects before the first use of PRO-MAPP was essential to ensure a successful implementation process.

People sign-off: The clinical administration and operations were fully prepared, with staff training completed and the administrative and clinical teams ready to start.

Process sign-off: Verified all necessary documentation, such as SOPs and DPIA.

Technology sign-off: The final review and testing of PRO-MAPP were conducted to ensure it met all the requirements and specifications. The functionality of PRO-MAPP was thoroughly tested, and all stakeholders were satisfied with the outcome. It is worth noting that during the project, a few design iterations were made to PRO-MAPP as the clinical and administrative team requested improvements to capabilities, usability and efficiencies.

5. Health Economic Evaluation Results

5.1. Base Case Analysis

The health economic analysis from YHEC demonstrated that the PRO-MAPP pathway was more cost-effective than the standard pathway (see Table 3). During this real-world evaluation, 734 patients were triaged by PRO-MAPP. The PRO-MAPP and the standard pathways used a hypothetical cohort of 1,000 patients based on real-world evidence collected. The PRO-MAPP pathway cost £2,958 per patient, while the standard pathway cost £3,728 per patient. This economic analysis was based on a cost minimisation method, which compared the cost of alternative interventions with equivalent medical effects. Additionally, the results assumed that patient outcomes were equivalent in both pathways. It was challenging to measure the impact of PRO-MAPP on patient outcomes within the short evaluation timeframe and data available because other factors also contribute to patient outcomes that the model did not consider.

Flo – the YHEC model scales to a cohort of 1,000 patients, but does the report say anywhere how many patients were actually enrolled (that the 1,000 was scaled from)? I may just have missed it…?

Table 3: Total model results

Total cost	**PRO-MAPP**	**Standard pathway**	**Difference**
Total cost per person	£2,958	£3,728	-£769
Total cost per cohort	£2,958,279	£3,728,223	-£769,944

Table 4 displays a cost breakdown of areas where PRO-MAPP has the potential to reduce resource use and, therefore, cost. This includes patient management, where PRO-MAPP per 1,000 users cost £52,320 less than patient management in the standard pathway. The length of stay post-surgery per 1000 was reduced by £617,899 in the PRO-MAPP pathway compared to the standard pathway. Preoperative tests per 1000 users cost £146,930 for PRO-MAPP compared to £234,790 for the standard pathway. The cost of preoperative appointments per 1,000 users for PRO-MAPP was £19,583 compared to £51,000 for the standard pathway. 75% of patients on the hip and knee surgical waiting list triaged by PRO-MAPP were suitable for telephone POA appointments.

Table 4: Cost breakdown

Cost breakdown (cohort)	**PRO-MAPP**	**Standard pathway**	**Difference**
Patient management	£100,680	£153,000	-£52,320

Length of stay post-surgery	£2,671,534	£3,289,433	-£617,899
Preoperative tests	£146,930	£234,790	-£87,859
Preoperative appointments	£19,583	£51,000	-£31,416

Table 5 displays the percentage of readmissions within 30 days. 1.5% of patients on the PRO-MAPP pathway were readmitted to the hospital within 30 days for problems related to the surgery, compared with 1.9% readmissions in the standard pathway. Table 6 outlines the percentage of surgeries cancelled in the PRO-MAPP and standard pathway. There was a 1.3% reduction in surgeries cancelled in the PRO-MAPP pathway compared with the standard pathway. The readmission and surgeries cancellation numbers were not included in the final cost breakdown as there was such a minimal difference.

Table 5: Readmissions (within 30 days)

Readmissions	**PRO-MAPP**	**Standard pathway**	**Difference**
Percentage of readmissions (within 30 days)	1.5%	1.9%	-0.4%

Table 6: Surgeries cancelled

Surgeries cancelled	**PRO-MAPP**	**Standard pathway**	**Difference**
Percentage of surgeries cancelled	3.3%	4.6%	-1.3%

5.2. Scenario Analysis

YHEC also conducted scenario analysis on a hypothetical cohort of 1,000 users in the PRO-MAPP and standard pathway to assess the impact on the model results of uncertain inputs. The preoperative tests were valid for three months and the first scenario assumed that 10% of preoperative tests would need to be repeated in the standard pathway because their validity expired due to the long waiting lists. One of PRO-MAPP's value propositions is reducing the number of tests repeated due to improved patient triage to guide appropriate tests. Table 7 illustrates the total cost per 1,000 users for preoperative tests in the standard pathway when they need to be repeated twice. This led to a saving of £111,338 in the PRO-MAPP pathway compared with the standard pathway.

Table 7: Scenario 1: Preoperative tests

	PRO-MAPP	**Standard pathway**	**Difference**
Preoperative tests	£146,930	£258,269	-£111,338

The second scenario modified the number of preoperative appointments in the standard pathway. In the base case analysis, it was assumed to be one, but in this scenario, two preoperative appointments are required in the standard pathway. The PRO-MAPP pathway resulted in a cost saving of £82,426 compared to the standard pathway. Table 8 presents the cost per 1,000 users of the preoperative appointments in the PRO-MAPP pathway compared to the standard pathway.

Table 8: Scenario 2: Preoperative appointments

	PRO-MAPP	**Standard pathway**	**Difference**
Preoperative appointments	£19,583.99	£102,000.00	-£82,416.01

The third scenario excluded the length of stay data from the analysis as many factors besides POA can influence the length of stay, such as the availability of community care. The results in Table 9 show that the PRO-MAPP pathway was cost saving compared to the standard pathway. PRO-MAPP pathway cost £286 per patient annually compared with the standard pathway, which cost £438 per patient.

Table 9: Scenario 3: Total model results

Total costs	**PRO-MAPP**	**Standard pathway**	**Difference**
Total cost per person	£286	£438	-£152
Total cost per cohort	£286,745	£438,790	-£152,044

The health economic report is available on request [6].

6. Staff Engagement Results

Oxford AHSN and NOC agreed upon a mixed methodology approach of collecting staff views on the implementation of PRO-MAPP. A combined methodology approach of online survey and semi-structured interviews were used to understand the current working environment and the impact of PRO-MAPP on the workforce. The workforce evaluations were supported by Community Involvement and Workforce Innovation team at the Oxford AHSN.

PRO-MAPP was introduced in April 2022 to triage hip and knee surgical waiting list patients. Before its implementation, staff members were interviewed in December 2021 to gather their views on what worked well, areas of concern, and their vision of an ideal working environment. An online survey was conducted during the real-world evaluation and designed from themes arising from the staff interview in December and a synopsis of the staff responses. 33 staff were invited to take part in interviews and online surveys: six staff took part in semi-structured interviews before the implementation of PRO-MAPP and 14 completed the online survey during the real-world evaluation. The online survey participants ranged from salary grade one to three (22%), grade four to five (14%), to six to seven (64%). The staff felt that the PRO-MAPP would be helpful within the service and had many ideas about its implementation, the full report on the Oxford AHSN website [7].

6.1. Patient Impact from a Staff Perspective

The patient benefits suggested by staff included reducing hospital visits, reducing travel time, early health promotion where medical issues are identified, reducing the risk of postponed surgery and the possibility of earlier surgery for some patients. Several staff identified that patients misinterpreted their PACT visit as their pre-assessment, thinking surgery would be imminent post-triage. Furthermore, some patients needed help answering the relevant health questionnaires using the iPad provided for the purpose.

7. Patient Engagement Results

In February and March of 2023, a patient survey was conducted at the NOC to gather feedback on their visit and the services provided. Patients were randomly selected and surveyed after completing health screenings and occupational therapy questionnaires as part of the PACT pathway. Appendix 1 contains the questions asked during the patient survey.

A total of 39 patients responded to the survey. They were from a range of ages, with the highest number of respondents falling into the over 70 years age bracket, see Figure 5.

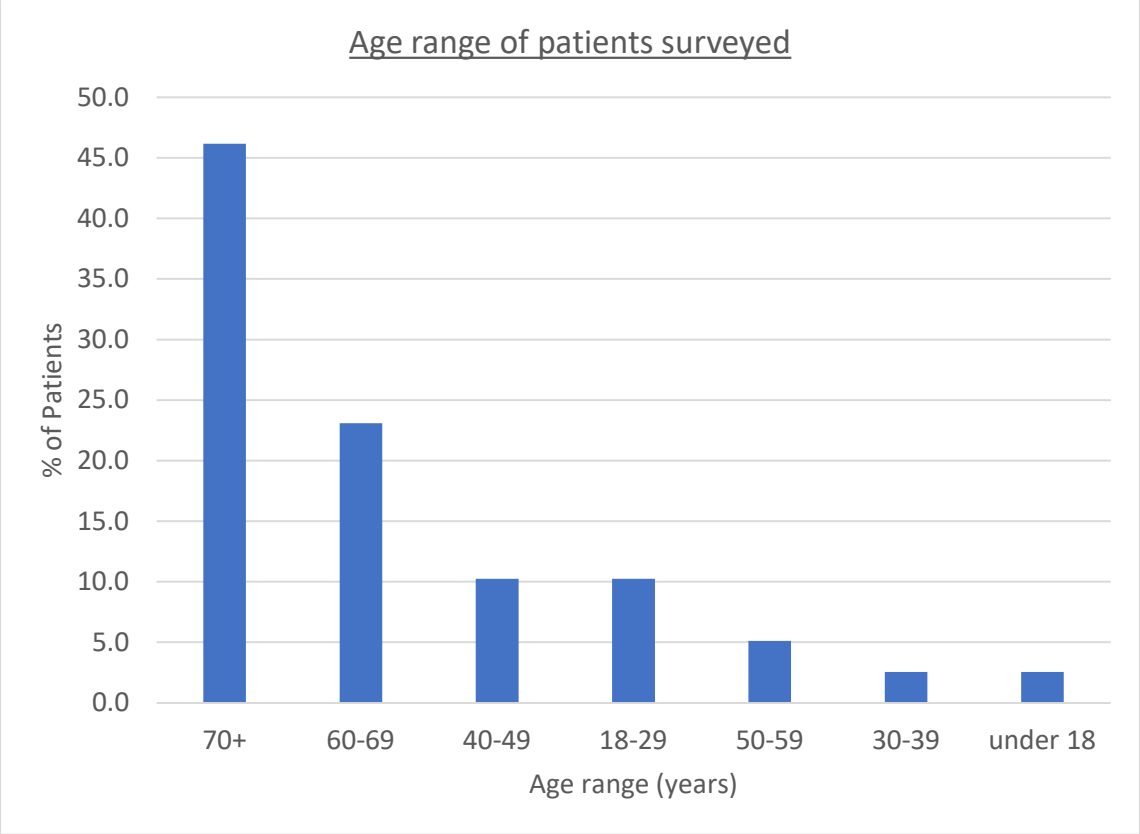


Figure 5: Age range of patients surveyed.

92% of patients surveyed stated that they found completing the questionnaires on the tablet either easy or very easy, see Figure 6. However, 3% of patients found completing the questionnaires on the tablet difficult, while 5% found it “neither easy nor difficult”. Some patients highlighted that they had help completing the questionnaires and could not change the font on the tablet. Other feedback received included that the staff were kind, efficient and caring. Patients stated there were no long queues or waiting times and were happy with the service.

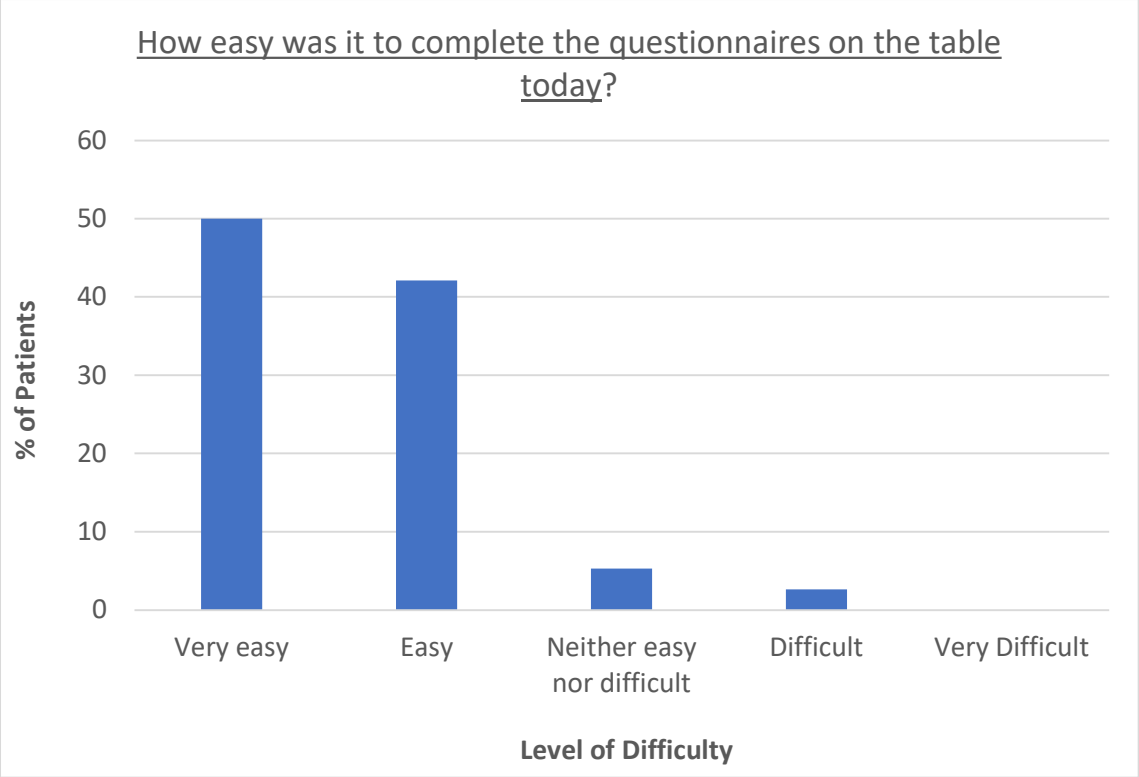


Figure 6: How easy was it to complete the questionnaire on the tablet today?

All patients surveyed were either satisfied or very satisfied with their visit, indicating that there are few barriers to adoption from a patient perspective, see Figure 7.

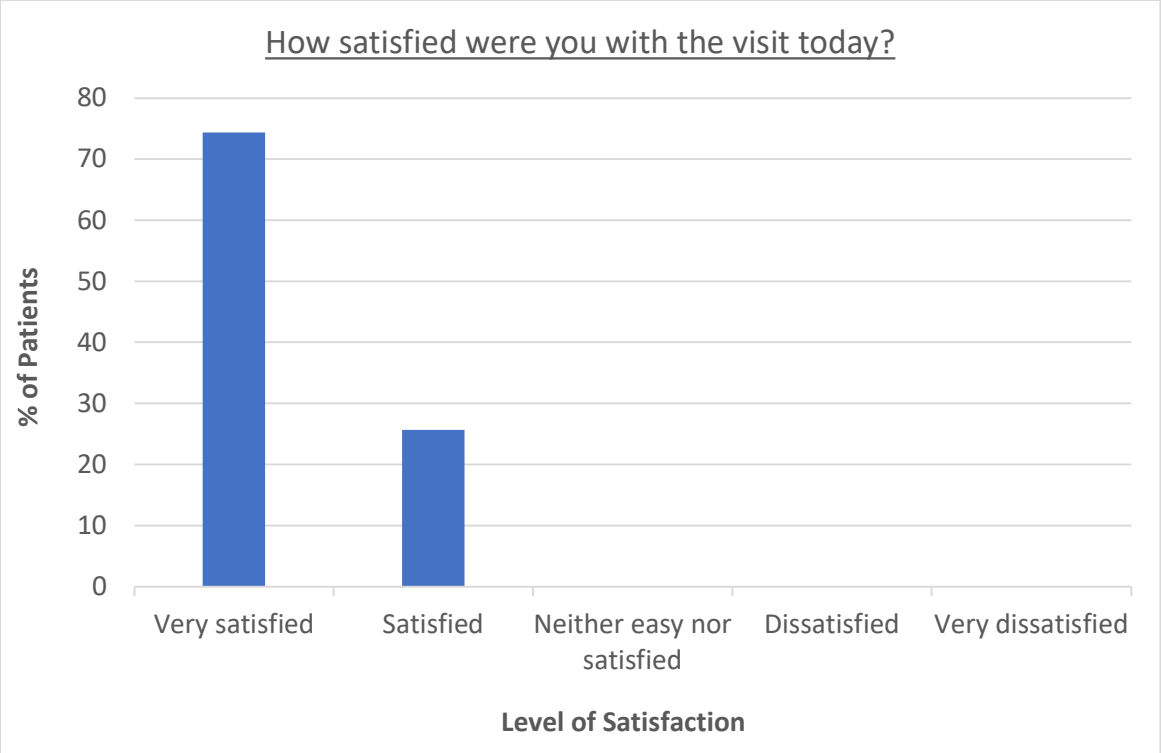


Figure 7 How satisfied were you with the visit today?

6.2. Quotes From Patients

"I was sent to the wrong area and waited an hour and a half."

"Seen on time and very competently processed."

"We did not have to wait long and appreciated the NHS is under a lot of pressure."

"Without help, I would not be able to fill in the form due to poor eyesight."

"Dr was extremely thorough and direct. Went straight to the outcome. Full explanations were given-instilled confidence."

"A very thorough and excellent service"

"Kept informed on where we were going."

"Not used to using a keyboard."

"Inside the hospital was good, but the car park was very busy and not enough spaces, so I was late for the appointment."

"Had short notice app assigned and all checks (preoperative) carried out in efficient and friendly fashion."

"Great visit. Easy to have everything sorted in one day."

"I am LD, so don't use a tablet or IT."

8. Sustainability and Social Value Report

The Environmental Sustainability Lead for the Oxford and Kent Surrey Sussex AHSNs conducted a Sustainability and Social Value analysis for PRO-MAPP, based on the evaluation undertaken. The full report is available on request [8].

The NHS is responsible for significant carbon emissions from patient, visitor, and staff travel, accounting for approximately 14% of its carbon footprint. PRO-MAPP has reduced patient travel by eliminating the need for non-medically complex patients to visit the hospital for their POA. Over 70% of patients added to the hip and knee surgical waiting and triaged by PRO-MAPP are suitable for a telephone POA after an outpatient clinic appointment, reducing the need for additional in-person hospital appointments. Additionally, medically complex patients who require face-to-face appointments and specific procedures/investigations only need to visit the hospital once for a combined appointment, further reducing patient travel.

During this real-world evaluation, PRO-MAPP has saved 51,381.6km of travel based on patient postcodes and travel distance to the NOC. In the UK, average CO_2 emissions per car equate to 171 grams per km, according to the latest data from the Department of Transport [1]. Therefore, this equates to 8.8 tonnes of CO_2 being saved.

For comparison, 1 tonne of CO_2 is the equivalent of a return flight from Paris to New York, meaning that PRO-MAPP has saved almost nine return flights from Paris to New York.

9. Lessons Learnt

Need a wide range of teams engaged to facilitate implementation - clinical, admin, operational, IT and IG to name a few. It was important to understand the barriers and issues surrounding the implementation.

A communication plan should be developed which aligns the stakeholders with their needs. Effective language and approaches that resonated with each group were utilised. It was essential to have engaged all stakeholders at an early stage for a smooth rollout.

Co-production with clinicians and users was crucial to the development of an innovation that would be successful in the NHS. Staff and patient feedback were conducted during the implementation process, and it was recognised as important to gather feedback from them throughout the process.

Consider reallocating resources after the implementing PRO-MAPP.

At the onset of the project, the desired outcomes and metrics should be agreed upon. It was crucial to notify the informatics teams in advance to allow ample time for resource planning and efficient data collection.

The target population and desired outcomes should be clearly defined. The team started with one speciality/ small cohort and scaled in phases as they refined their approach.

Effective communication between POA and other teams was essential to ensure all patients deemed 'fit for surgery' were referred promptly.

It was crucial to have a clinical champion.

Some patients expect to have their surgery shortly after assessment due to having tests on the day of the decision to add them to the surgical waiting list. Clear communication is key to ensuring patients understand the process and benefits of having early assessments. Set expectations and explain the new approach to POA process.

Complex patients are undergoing multiple investigations under different specialties. As a result, it is crucial to establish an efficient workflow for compiling and communicating outcomes, and making the final decision on the patients' suitability for surgery. This is necessary to prevent the risk of on the day cancellations.

Conduct training and create guides for nursing and administration staff. Detailed training for outpatient staff maybe required as this is a different way of seeing patients and may increase confidence when patients need assistance with enquiries.

It was essential to pay attention to what is not working not just what is working.

On busy days in clinics, patients might experience longer than the usual waiting time for triage therefore expansion of capacity is to be considered. Set expectation with the patients and inform them of new approach to their outpatient appointment prior to attending the clinic.

Introducing a preoperative assessment (POA) triage influenced every stage of the patient pathway.

10.Case Studies

Below are references to two PRO-MAPP case studies showcasing the advantages of digital innovation in streamlining the preoperative process, which leads to improved patient experience, efficiencies in the pathway and cost savings to the system. Moreover, NHS England visited the NOC to see the innovation in action.

"Thank you for inviting us to see the innovative work you are doing for your patients, providing person-centred pre-operative care with digital technology."

Rachel Brown – Senior Project Manager, Digital Care Models Team, NHS England Transformation Directorate

10.1. NHS Digital Playbook for Perioperative Care

The utilisation of PRO-MAPP in a PACT pathway has been recognised as a national exemplar of best practices in the NHS [9]. This case study was approved by the National Clinical Director for Critical and Perioperative Care of NHS England and is now incorporated in the NHS Digital Playbook for Perioperative Care [9].

The NHS Digital Playbook for Perioperative Care provides clinical teams and organisations with various digital tools and case studies to facilitate the delivery of perioperative pathways, from primary care to postoperative follow-up [10]. It provides digital solutions for:

- shared decision-making and digital consent for treatment
- supporting patients in preparing for surgery.
- supporting the physical and mental health needs of patients before and after surgery
- preoperative assessment.

10.2. NHS England: Earlier screening, risk assessment and health optimisation in perioperative pathways: a guide for providers and integrated care boards

A PRO-MAPP case study has also been included on NHS England's website as a guide for providers and integrated care boards on earlier screening, risk assessment and health optimisation in perioperative pathways [11]. NHS England has developed this guide in partnership with the Centre for Perioperative Care and the Royal College of Anaesthetists.

11. Next Steps

11.1. Business Case Development

The NOC has received encouraging results from the real-world evaluation of PRO-MAPP, prompting them to develop a business case to endorse the implementation of PRO-MAPP throughout the orthopaedic department and spread and adoption into other specialties within OUH. The health economic analysis done by YHEC is being used to support business case development. Alongside the financial benefits, other benefits demonstrated during this real-world evaluation include operational and environmental, sustainability and social values. PRO-MAPP delivered improved efficiencies through a streamlined POA process, early patient optimisation in the clinical pathway and reallocating of resources. Another advantage of PRO-MAPP is that it expands the pool of patients who are deemed suitable for surgery supporting elective recovery.

Various stakeholders are collaborating to develop a strong business case for adoption, including a clinical champion, operational leads, service leads, clinical director, and procurement and finance leads. The business case's format and content will depend on the scale and type of investment being requested. PRO-MAPP is licensed per specialty and the yearly license fee for each specialty is £15,000-£50,000 depending on specialty and workflow. It covers staff training, support, and maintenance. If the proposal is significant enough, the Five Case Model may be used to develop the business case, which includes demonstrating the strategic, economic, financial, management and commercial cases [12].

11.2. Implementation Support Pact

The Oxford AHSN is creating an implementation support pack to help roll out this innovation across the wider NHS. The document will include helpful resources and insights based on real-world evaluation and lessons learned at the NOC. Health and care stakeholders can utilise this valuable information to facilitate a successful implementation of PRO-MAPP. Once completed this will be available through the Oxford AHSN website and available on request.

12. Conclusion

PRO-MAPP is an engagement tool for patients and healthcare staff, providing intelligent decision support to streamline the POA process. It was used for POA triage and stratification of HVLC orthopaedic cases. It identifies medically complex cases and allows personalised care for patients on surgical waiting lists and early patient optimisation in the clinic pathway.

The results of the health economic analysis indicated that implementing PRO-MAPP into the clinical pathway for those on the hip and knee surgical waiting list was cost saving. The decision model concluded that there was a cost saving of £769 per patient in the musculoskeletal pathway when the length of stay was included. However, there was an average cost saving of £152 per patient in the PRO-MAPP pathway when considering all metrics apart from the patient's length of stay. A potential way PRO-MAPP could reduce the length of stay is the improved preoperative medical optimisation and occupational therapy input; however, there are several confounding factors to consider when looking at changes to the length of stay. The reduction in length of stay post-surgery pathway in the PRO-MAPP pathway is an area that requires further research to determine any potential impact on health outcomes.

PRO-MAPP reduced surgery cancellation rates and preoperative appointment cancellations, leading to better resource utilisation and further cost savings. It also reduced outpatient footfall and unnecessary patient travel. PRO-MAPP reduced patient travel by 51,381.6 km, saving 8.8 tonnes of CO_2. This is equivalent to almost nine return flights from Paris to New York. The feedback from patients was overwhelmingly positive, as they all expressed satisfaction with their visit. Moreover, 92% of them found the questionnaire to be easy or very easy to complete.

13. User Quotes

"Our new clinical pathway has enabled us to increase preoperative assessment capacity and commence patient optimisation as soon as individuals are listed for surgery. It has also allowed us to digitise the pathway, reduce hospital visits and improve carbon footprint."
Antony Palmer - Consultant Orthopaedic Surgeon, Clinical Lead for NOC Preoperative Assessment, OUH

"The PACT project has transformed the way we provide pre-assessment care for patients. It is a fantastic example of digital enhancement of a clinical pathway improving patient experience."
Professor Andrew Price -Trauma and Orthopaedic Surgery Clinical Director, OUH

"Triaging patients earlier in their surgical pathway has improved the optimisation and management of their complex long-term conditions. This allows the follow-up of patients to be arranged in a timely manner and to reduce unnecessary visits to the hospital."
Natasha Brand- Specialist nurse practitioner, Pre-Assessment Clinic, OUH

"The benefit of PACT is to work in a different and effective way to enable us to have a pool of patients fit for surgery so then if we do have any last-minute cancellations, then we have patients to fill the gaps rather than wasting precious theatre time. Regarding staffing efficiencies, I think PACT has helped develop staff and provide them with additional responsibilities within their role. For example, a nurse associate band four can be given more autonomy to assist with this procedure. This enables the pre-op team to spread their workload effectively and fairly and enable staff to see more patients."
Lucy Barrett- Deputy Matron for Orthopaedics, OUH

14. Key Contact

Antony Palmer - Consultant Orthopaedic Surgeon, Clinical Lead for NOC Preoperative Assessment
Antony.Palmer@ouh.nhs.uk

Flora Gleave - Project Manager, Oxford Academic Health Science Network
flora.gleave@oxfordahsn.org

Michael Phillips - Founder and Director, PRO-MAPP Limited
Michael.Phillips@PRO-MAPP.com

15. References

[1] "https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020," 2020. [Online].

[2] "Funding opportunities to improve digital pathways," NHS Transformation Directorate, NHS England, [Online]. Available: 2. Funding opportunities to improve digital pathways - Key tools and information - https://transform.england.nhs.uk/key-tools-and-info/funding-opportunities-to-improve-digital-pathways/. [Accessed July 2023].

[3] Centre for Perioperative Care, "Strategy for the Centre for Perioperative Care (CPOC) 2023–2026," Centre for Perioperative Care (CPOC), February 2023. [Online]. Available: https://www.cpoc.org.uk/sites/cpoc/files/documents/2023-02/CPOC-Strategy2023.pdf. [Accessed July 2023].

[4] "Centre for Perioperative Care. Impact of perioperative care on healthcare resource use.," Centre for Perioperative Care, June 2020. [Online]. Available: https://cpoc.org.uk/sites/cpoc/files/documents/2020-09/Impact%20of%20perioperative%20care%20-%20rapid%20review%20FINAL%20-%2009092020MW.pdf. [Accessed July 2023].

[5] National Institute for Clinical Excellence, "Routine preoperative tests for elective surgery, NICE guideline [NG45]," Routine preoperative tests for elective surgery NICE guideline [NG45], 05 April 2016. [Online]. Available: https://www.nice.org.uk/guidance/ng45. [Accessed July 2023].

[6] York Health Economics Consortium "Economic Analysis of Digital Interventions to Improve the Perioperative Care Pathway in BOB ICS," York Health Economics Consortium , 2023.

[7] Oxford Academic Health Science Network, "Introducing innovation in the peri-operative care pathway," February 2023. [Online]. Available: https://www.oxfordahsn.org/our-work/our-programmes/community-involvement-and-workforce-innovation/workforce-innovation/real-world-evaluation/introducing-innovation-in-the-peri-operative-care-pathway/. [Accessed July 2023].

[8] Oxford Academic Health Science Network, "PRO-MAPP: Sustainability and Social Value Review," Oxford Academic Health Science Network, 2023.

[9] NHS. England. -Transformation Directorate, "Digital preoperative assessment triage," NHS England - Transformation Directorate, 2022. [Online]. Available: https://transform.england.nhs.uk/key-tools-and-info/digital-playbooks/perioperative-digital-playbook/digital-preoperative-assessment-triage/. [Accessed July 2023].

[10] NHS. England. -Transformation Directorate, "Perioperative digital playbook," NHS England - Transformation Directorate, [Online]. Available: https://transform.england.nhs.uk/key-tools-and-info/digital-playbooks/perioperative-digital-playbook/. [Accessed July 2023].

[11] NHS. England, "Earlier screening, risk assessment and health optimisation in perioperative pathways: guide for providers and integrated care boards," May 2023. [Online]. Available:

https://www.england.nhs.uk/long-read/earlier-screening-risk-assessment-and-health-optimisation-in-perioperative-pathways/. [Accessed July 2023].

[12] H. Treasury, “GUIDE TO DEVELOPING THE PROJECT BUSINESS CASE,” HM Treasury, 2018. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749086/Project_Business_Case_2018.pdf. [Accessed July 2023].

16. Appendix

Appendix 1: Questions asked during the patient survey.

NHS

Oxford University Hospitals

NHS Foundation Trust

NOC Patient Feedback

* 1. What is your age?

- ◯ Under 18
- ◯ 18 - 29
- ◯ 30 - 39
- ◯ 40 - 49
- ◯ 50-59
- ◯ 60-69
- ◯ 70+

* 2. How easy was it to complete the questionnaires on the tablet today?

- ◯ Very easy
- ◯ Easy
- ◯ Neither easy nor difficult
- ◯ Difficult
- ◯ Very difficult

* 3. How satisfied were you with the visit today?

- ◯ Very satisfied
- ◯ Satisfied
- ◯ Neither satisfied nor dissatisfied
- ◯ Dissatisfied
- ◯ Very dissatisfied

Please can you tell us why you gave your answer.

4. Do you have any other feedback from the service you experienced today?