Oxford
Academic Health
Science Network

Intraoperative Fluid Management (IOFM) Benchmarking Project Report

Oxford Academic Health Science Network

About Oxford Academic Health Science Network (AHSN)

Berkshire, Buckinghamshire, Oxfordshire, Milton Keynes and Bedfordshire are home to a wealth of world-leading organisations involved in clinical care, life sciences and medical research, education and training, innovation and informatics.

The Oxford Academic Health Science Network brings together the NHS, universities, business, patients and the public to promote best health for our population and prosperity for our region.

We work to break down traditional organisational boundaries to build stronger relationships between industry, scientific and academic communities and work to spread best practice quickly and widely across the NHS to benefit patients.

Contact details:
http://www.oxfordahsn.org/

Tracey Marriott, Director of Clinical Innovation Adoption
tracey.marriott@oxfordahsn.org

About NHS Benchmarking Network

The NHS Benchmarking Network is the in house benchmarking service of the NHS promoting service improvement through benchmarking and sharing good practice. The Benchmarking Network works with over 350 member organisations to understand the wide variation in demand, capacity and outcomes evident within the NHS and define what good looks like. This supports providers in delivering optimal services within resource constraints, whilst also allowing commissioners to achieve the best balance from available commissioning resources. Delivery of good outcomes and excellent patient experience is part of our work in sharing best practice across the NHS and other health and social care services.

Contact details:
http://www.nhsbenchmarking.nhs.uk/

Aidan Rawlinson, Programme Manager
aidan.rawlinson@nhs.net

Contents

Foreword

A key role of Academic Health Science Networks is to support more rapid uptake of innovation by the NHS to improve patient outcomes, patient safety and deliver better value. Each year the Oxford AHSN team selects clinical innovations that align to national and local commissioner and provider strategic priorities. I am delighted to introduce the results of the clinical innovation adoption team's benchmarking exercise to review the adoption of Intraoperative Fluid Management technology. From the outset of the AHSN we have recognised that clinician engagement will determine successful implementation of innovation. The benchmarking dataset was developed by consultant anaesthetists and theatre nurses from hospitals across the Oxford AHSN region. Clinicians from the Central Manchester Teaching Hospitals have also been key members of the project group facilitating sharing of learning between both AHSNs. Key to the success of the project has been the support from clinicians in all of our hospitals. Information from the benchmarking dataset will help acute Trusts develop their services and implementation plans to spread adoption of technology and assure clinical commissioning groups that their patients are receiving high quality care.

Professor Gary Ford,
Oxford AHSN Chief Executive

The results of our work raise important points for how Trusts can best develop their use of Intraoperative Fluid Management and will be shared with the other AHSNs to ensure this learning is spread across the country. Intraoperative Fluid Management (IOFM) or Goal Directed Fluid Therapy is still a young technology where researchers, industry and clinicians are constantly developing our understanding of the impact of the fluid status of patients, developing technologies to measure and quantify it and are innovating to develop tools that can be used to assist clinicians in optimising the care they can provide. The collaboration with NHS Benchmarking Network enabled us to use skills from both organisations to deliver a successful project in this evolving area where there were no pre-existing data collections and relevant data can be difficult to obtain. The AHSN is working with the Benchmarking Network, NHS England and Trusts to examine options to develop national IOFM benchmarking based on the work of this project.

Tracey Marriott,
Director of Clinical Innovation Adoption, Oxford AHSN

I was pleased to be asked by the Oxford Academic Health Science Network to act as the Clinical Champion for this Intraoperative Fluid Management project. The project has provided Trusts in the region with the opportunity to work together to examine the current state of adoption of this technology and to share our experiences and views with it.

I am delighted that all the Trusts in the region engaged with the project and would like to thank Central Manchester University Hospital Trust for joining in. It was especially pleasing that 138 anaesthetists from across the participating Trusts took the time to complete our user survey as this enables us to get a really good picture of the practice and perspectives of the people who use these technologies in their work.

The project has been timely as Trusts and their commissioners have had a year to develop their local approaches since the end of the 2013/14 CQUIN pre-qualifier. The pre-qualifier greatly increased awareness of these technologies across the country. However, if we are to be confident that our approaches are the best to meet patient needs we need to look forward and working collaboratively with our peers is a great way to make sure that the knowledge is spread across the region.

Dr Emmanuel Umerah,
Oxford AHSN IOFM Clinical Champion,
Consultant Anaesthetist and Deputy Medical Director,
Frimley Health NHS Trust

2: Executive Summary

Each year the Oxford AHSN team selects ten clinical innovations that align to national, local commissioner and provider strategic priorities. Intraoperative Fluid Management was selected in the 2014/15 work programme and a project has been delivered with the key aim of supporting the increase of relevant use of this technology across the Oxford AHSN region. The CIA programme was also fortunate to receive funding from the NHS England Regional Innovation Fund for this project.

2.1: The Research

In 2011 to 2014, IOFM technology received considerable attention as a High Impact Innovation that would have a significant impact on patient recovery and should be implemented at pace and volume across the NHS. There were a number of randomised controlled trials on IOFM technologies during this period that pointed to benefits such as improved postoperative outcomes for patients and reduced length of stay. None of the initial studies considered comparison of technologies and all involved small trials. The largest known trial at the time of writing this summary is the 'OPTIMISE' trial (Optimisation of Cardiovascular Management to Improve Surgical Outcomes) conducted in 17 NHS trusts and involving 734 high risk patients aged 50 years or older undergoing gastrointestinal surgery. 'OPTIMISE' included an updated systematic review and meta-analysis including randomised trials published from 1966 to February 2014. Results were published in the 'American Medical Association in May 2014' and showed a reduction in the number of patients who developed complications after surgery such as infections (see bibliography for trial details).

It is important to note that the Oxford AHSN IOFM Benchmarking Project does not seek to conduct or comment on trials but to gather regional information that may give further insight into the present position of usage and opinion.

2.2 IOFM – Regional Adoption Progress

In England, usage increased between 2011/12 and 2013/14 with the CQUIN pre-qualifier being a key driver of increased awareness of these technologies. Since the end of IOFM being included as a CQUIN pre-qualifier, policy on the use of IOFM technology has been set locally by Trusts with limited roles played by Clinical Commissioning Groups. In most cases usage has largely remained stable, although one Trust has reported a reduction.

Following initial consultations with the Clinical Lead for the project and regional Trusts, it became apparent that there was little information available as to how successful implementation has been and on current practice. During initial implementation, the CQUIN did have a significant impact on the levels of usage. However, there was little information as to on-going usage rates, availability of equipment and the approaches being taken by different Trusts. With this in mind, the Oxford AHSN commissioned the expertise of NHS Benchmarking to support the programme with the development of a benchmarking project.

2.3 The Oxford AHSN's IOFM Project and Summary

The project examined four perspectives on IOFM:

- User Perspective
- Trust Perspective
- Supplier Perspective
- Commissioner Perspective

The study found that:

- Prior to the 2013/14 CQUIN pre-qualifier, Trusts had different experiences of IOFM usage with some early adopters having the technology embedded in practice and others having limited experience.

- On average, participating Trusts in our region had 10 monitors available, which equated to approximately one monitor for every two theatres. The type of monitors available varied between Trusts. On average, each Trust had three monitor types available however, this ranged from only one model type to six different model types.
- The two most popular models of IOFM monitor were the Deltex Medical Ltd CardioQ-ODM monitor and the LiDCOrapid Hemodynamic Monitor with 33 and 29 monitors in the region respectively. Together these two models accounted for 72% of monitors reported by Trusts in the region.
- A detailed examination of Trusts' standard practice by procedure type was undertaken to identify the procedures where Trusts are prioritising use of IOFM and those where it is not being used as frequently. As well as reviewing use of IOFM technology for procedure types stated in the CQUIN pre-qualifier, the study also examined emergency laparotomy, revision hip surgery and fractured neck of femur.
- A 10 week audit of IOFM use in the region highlighted the challenges that Trusts face in recording, coding and analysing information on their use of IOFM. The Trusts that were able to provide information had a 67% use rate for the CQUIN procedure list, which demonstrates that use is well embedded in these Trusts.
- The average cost per use of IOFM for the Trusts was £75. Experience from participants shows that it is important that Trusts have support from senior management to ensure that Trusts take a co-ordinated approach to procurement and financing in order to maximise spending power and to ensure that silo budget management does not present a block to the invest-to-save opportunity.
- The patient cohorts that Trusts reported as being more likely to have IOFM technologies included in their treatment were emergency laparotomy, free flaps, hip replacements and elderly/fragile patients.
- The most common cases where anaesthetists reported being less likely to use IOFM related to low risk surgeries e.g. surgery with young fit patients or procedures that took a short length of time.
- All the participating Trusts use monitors in critical care, 57% used it in PACU/Level 1 and 17% in other locations.
- The LiDCOplus monitor was the only monitor type that was more frequently used in critical care than in theatres.
- Of the six Trusts that were able to identify historical use, five showed an increase in usage over the time period with four Trusts more than doubling their use. One Trust's level of use remained constant over the period reflecting their 'early adopter' status.
- 80% of the 138 anaesthetists surveyed agreed that they saw a clinical value in IOFM. 72% reported having received formal training. 60% only normally use one type of monitor.

2.4: The Recommendations

Based on the key areas that have emerged from this project, we make the following recommendations:

Recommendation #1 – Application of the Technology – IOFM Policies:

Developing appropriate IOFM policies will benefit from further study as the discussion moves away from whether or not IOFM is being used, to how to optimise its use.

For those procedures where there is evidenced-based opinion that IOFM is of benefit such as gastrointestinal surgery, laparotomy and emergency laparotomy, Trusts should look to embed this into their normal contract.

To enable this, Trusts should implement a clear policy with regards to procurement and financing so as to harness purchasing power and to reduce the likelihood of silo budgeting decisions – focus should be on value for money and spend to save rather than just cost. High-level support at Trusts is important to drive business cases and ensure suitable priority in the procurement process.

Recommendation #2 – IOFM Benefits and their realisation:

One of the key challenges that was repeatedly mentioned during this study was the "lack of robust evidence" to substantiate the benefits of using the technology.

This report mentions a number of procedures that anaesthetists use IOFM for and that the literature research undertaken revealed that a limited number of research and evaluation projects have been conducted worldwide that prove the benefits of IOFM for certain procedures. Communication of this to clinicians and managers may drive up utilisation.

This finding also increases the importance of collecting local data and information to gain further insight into how patients may benefit.

Trusts should seek to improve and integrate the collection, recording, coding and analysis of data so as to improve decision making and to develop plans. Ideally, data on IOFM should be collected and made available internally and externally for the purpose of anonymised evaluation. This may encourage a wider list of procedures to become part of mainstream IOFM planning.

Recommendation #3 – Training:

Sustainable Improvement to the health system is reliant on Consultants and Junior Doctors being encouraged to adopt new ways of working and having the opportunity to train on these new technologies where the benchmarking process shows definite benefits.

A training programme/s could be developed and implemented for clinicians. This may be in the form of job training and/or formalised opportunities to train either from experienced colleagues or/and suppliers.

Recommendation #4 – Further Research:

It may be of interest to research bodies such as the CLARHC (Collaboration for Leadership in Applied Health Research and Care) to work on studies with the NHS on IOFM linked to specific procedures such as colorectal, gynaecology, orthopaedic, and urology as these are key areas where the Enhanced Recovery Programme has already demonstrated benefit. This study also gathered quantitative data from anaesthetists as to their usage. Other procedures where IOFM is being regularly used included 'total excision of pancreas' and 'spleen' and 'open excision of prostate' even though at the moment there is limited research evidence to support this. Further research and evidence gathering would strengthen 'in practise' usage and encourage increased levels of adoption.

3: Introduction

3.1: Intraoperative Fluid Management (IOFM)

Intraoperative Fluid Management (IOFM) refers to the actions taken by anaesthetists to optimise the patient's fluid status (state of hydration) during an operation. A patient's fluid status may significantly change during major operations especially in procedures involving significant blood loss.

During operations anaesthetists can intervene to improve the fluid status by administering fluid to the patient. Increased morbidity may arise as a result of under or over hydrating the patient intra-operatively.

IOFM management has been strongly linked with Enhanced Recovery.

The document 'Delivering Enhanced Recovery – Helping Patients to Get Better Sooner After Surgery' was published by the UK Department of Health Enhanced Recovery Partnership Programme on March 10, 2010. The progress review in November 2013 entitled 'Enhanced Recovery Care Pathway' reported successful national implementation in four main types of elective surgery - colorectal, gynaecology, orthopaedic, and urology - and demonstrated the benefits of the Enhanced Recovery programme for thousands of surgeries resulting in 170,000 fewer bed days being required. Target lengths of stay were achieved, readmission rates did not increase, and both quality and patient satisfaction was improved. From this work there developed a general consensus on the value of having a systematic approach to Enhanced Recovery.

Enhanced recovery pathways have the following key elements:

1) Pre-operative assessment: planning and preparation before admission.

2) Day of surgery admission: involve patient in care pathway, further optimisation and prepare for discharge.

3) Operation (Peri-operative): optimise fluid balance and cardiac function, pain control, minimising nausea, vomiting and infection.

4) Transfer to home/community: effective communications with primary and community team, criteria based discharge.

5) Follow up by telephone: care plan includes information on likely time to return to activity for daily living/work.

IOFM is a key step in element 3 during operations and where appropriate, the equipment can be used for post-operative monitoring of patients in ICU. All anaesthetists practice IOFM, but technology has developed to support anaesthetists to optimise fluid status for patients. These technologies work by monitoring heart rate, blood pressure and other inputs by using electrical waveforms and mathematical algorithms to calculate the cardiac output (volume of blood being pumped by the heart) and other indices of cardiac function. This provides an indication of the level of the patient's hydration which the anaesthetist can use to inform their interventions. There is a range of technologies produced and available from a number of different suppliers.

The reported benefits of adopting IOFM technology are:

- Reduced risk of cardiac complications
- Reduced risk of catheter (CVP, arterial, PAC) related infection
- Reduced length of hospital stay
- Fewer post-operative complications
- Reducing emergency admissions into intensive care after surgery
- Earlier detection of complications in surgery
- Reduced rate of re-admission and re-operation

IOFM is only one factor in patient outcomes and there is constant evolution both in the nature of surgery (e.g. development of laparoscopic and robotic surgery) and in IOFM technology. The benefits of the technology are difficult to measure accurately and have not yet been definitively quantified for all surgical procedures. This has fuelled the demand for evidence based on multi-centralised Randomised Controlled Trials despite the better outcomes noted by earlier adopters of the technology.

NHS Technology Adoption Centre (NTAC) Adoption Pack

In February 2013 the NHS Technology Adoption Centre published an "Intraoperative Fluid Management Technologies Adoption Pack" to support Trusts in adopting the technology. The pack included information about the benefits, national and local opportunities available, the drivers for adoption, the costs and potential savings of the technology. The pack cited research undertaken by NICE which estimated that use of IOFM would result in a saving of £493 per eligible surgical patient, through better outcomes and lower length of stay.

2013/14 CQUIN Pre-qualifier

The CQUIN payment framework enables commissioners to reward excellence, by linking a proportion of English healthcare providers' income to the achievement of local quality improvement goals. IOFM was included as a pre-qualifier for the 2013/14 CQUIN and in order to access CQUIN funding Trusts were required to work with commissioners to select a set of procedures and then to demonstrate that IOFM was used for 80% of these cases.

The CQUIN provided a strong incentive for Trusts to deliver IOFM and was a key driver for increased awareness for both providers and commissioners and for increased adoption across the country.

Uptake of IOFM remains within the NHS Standard contract.

3.2: Oxford AHSN IOFM Benchmarking Project 2014/15

Academic Health Science Networks (AHSNs) play a key role in supporting uptake of new technologies to enhance patient care and outcomes.

Each year the Oxford AHSN's Clinical Innovation Adoption programme team identifies 10 priority areas/ innovations to support and IOFM was selected during 2014/15. The main aim of the IOFM project is to promote the increased clinically relevant use of IOFM technologies across the Oxford region.

The project was also fortunate to receive funding from the Regional Innovation Fund from NHS England.

The regional map below highlights the Trusts within the Oxford AHSN.

NHS Trusts within the Network

1 Oxford University Hospitals NHS Foundation Trust
2 Oxford Health NHS Foundation Trust
3 Royal Berkshire NHS Foundation Trust
4 Berkshire Healthcare NHS Foundation Trust
5 Heatherwood and Wexham Park NHS Foundation Trust
6 Buckinghamshire Healthcare NHS Trust
7 Milton Keynes Hospital NHS Foundation Trust
8 Milton Keynes Community Services
9 Bedford Hospital NHS Trust
10 Southern Health NHS Foundation Trust

Figure 3.1.1 shows the number of theatres reported by NHS England statistics 2014/15 for each of the participating Trusts.

Fig 3.1.1 - No. Operating Theatres, 2014-15 Q4

Central Manchester University Hospitals NHS Foundation Trust	47
Bedford Hospital NHS Trust	10
Milton Keynes Hospital NHS Foundation Trust	12
Great Western Hospitals NHS Foundation Trust	15
Frimley Health NHS Foundation Trust	31
Royal Berkshire NHS Foundation Trust	20
Oxford University Hospitals NHS Foundation Trust	46
Buckinghamshire Healthcare NHS Trust	23

It should be noted that the Regional Trusts with multiple sites did not conduct the IOFM survey across all of their sites; Oxford University Hospitals NHS Trust and Central Manchester University Hospitals NHS Foundation Trust reviewed sites containing 24 and 30 of their theatres respectively.

The project is timely as following the end of the CQUIN pre-qualifier for IOFM there is a need to assess current practice.

Given that research has proven IOFM technologies' effectiveness for specific procedures and both quality improvement programmes and financial incentive such as the CQUIN have had an impact on the rate of adoption of this innovation, the project is timely for assessment of current practice in IOFM technologies.

This raises the following questions:

1) What is the current level of usage?

2) What variation exists between Trusts in the region in terms of access to technologies or how technologies are used?

3) Do anaesthetists see value in using IOFM technology?

4) What barriers exist to further relevant adoption of the technology?

5) How can Trusts and clinicians be supported to overcome these barriers?

The Oxford AHSN elected to partner with the NHS Benchmarking Network to develop and run a benchmarking project in order to address these questions. The NHS Benchmarking Network is the in-house benchmarking service of the NHS and has the necessary experience, processes and systems to complement the AHSN's work in the project. Project Management and Event Management was primarily led by Oxford AHSN and the development of the dataset, data collection, analytics and reporting was primarily led by NHS Benchmarking Network.

From the outset, the importance of clinical leadership was recognised and the project support team was delighted that Dr Emmanuel Umerah from Frimley Health agreed to act as the clinical lead for the project. A project reference group comprising of representatives from participating Trusts, led the development of all aspects of the project. The participation of Central Manchester University Hospitals NHS Trust led by Dr Daniel Conway, provided welcomed additional expertise, perspective and comparisons.

The purpose and objectives of the 2014/15 Oxford AHSN IOFM Benchmarking exercise was decided at the project initiation event hosted by Buckinghamshire Healthcare Trust at Wycombe Hospital in September 2014.

The purpose for doing the benchmarking exercise was agreed as being to "increase the relevant adoption of Intraoperative Fluid Management Technology across the region".

The objectives were agreed as:

- To better understand the views and experiences of IOFM of anaesthetists at participating Trusts
- To provide feedback to NHS England to inform future national policy
- To understand the barriers to adoption from the perspective of users, NHS Providers, NHS Commissioners and Industry
- To design and develop tools that providers and commissioners can use to inform business planning, service development and contract management.

The project commenced in September 2014 and the findings were presented in April 2015. This report presents the methodology used and summarises the findings of the project.

4: Terminology

AHSN: Academic Health Science Network

Intraoperative Fluid Management (IOFM) is the use of technology to support anaesthetists in optimising patients' fluid status during an operation. IOFM is also known as Goal Directed Fluid Therapy and Cardiac Output Monitoring.

Project Support Team refers to the colleagues from Oxford AHSN and the NHS Benchmarking Network who collaborated to deliver the project.

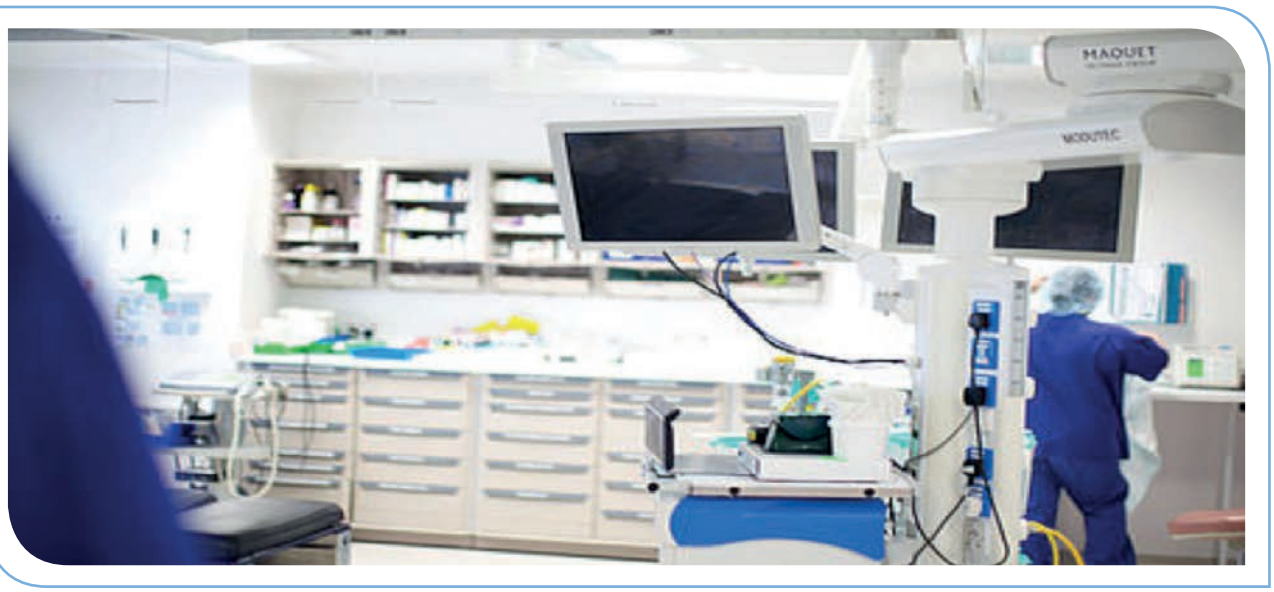
Project Reference Group refers to a group of clinicians from participating Trusts who advised on the project.

Trust lead: the designated lead at each of the participating Trusts.

Region/the region: This normally refers to the Oxford AHSN Region, however Central Manchester University Hospitals Trust agreed to participate and their results are also included in this report.

Monitors refers to the core IOFM machines; this usually includes a visual display providing readings for the users.

Disposables/probes are single-use components of the system that need to be purchased for each use. These can either be probes or 'cards' that activate the machine for a period of time.



5: Methodology

5.1: Project timetable

The project timetable showing the key project milestones is shown in figure 5.1.1

Figure 5.1.1 – Project Timetable	
September 2014	Initialisation event
October 2014	Draft questionnaire circulated
November 2014	Reference group teleconference
November 2014	E-mail consultation
December 2014	Data collection opens
December 2014	Site visits
January 2015	Peer group teleconference
February 2015	Data collection deadline
March 2015	Validation & Analysis
April 2015	Draft trust reports distributed
April 2015	Regional conference
May 2015	Final trust reports distributed
June – October 2015	Project summary report prepared & published
October 2015	Final Summary report distributed
October – December 2015	Next Steps agreed

5.2 Project initiation event

The project commenced with the 'Project Initiation Event' held at Wycombe Hospital in September 2014. Anaesthetists and theatre nurses from participating Trusts met with the project support team to discuss how the project could benefit their work and to agree the project timetable and approaches to be taken. The key conclusions from the meeting are detailed below:

- The representatives at the meeting agreed to form the core of the project reference group.
- It was agreed that the project provided a timely opportunity for Trusts to review their own use of IOFM and also understand how this compares to their peer Trusts.
- It was noted that views on IOFM and preferences for machines varied between anaesthetists and between Trusts. Some Trusts in the region had been early adopters of the technology, whilst others had only started using it in the last couple of years.
- As well as levels of usage and barriers to adoption, the project should also explore users' views, factors that impact on usage, availability of equipment and variation in practice between Trusts.
- While linking use of IOFM to outcomes would be highly desirable, the large number of factors influencing outcomes and small sample sizes would make it impossible to draw any definitive conclusions.
  In addition, it would not be possible to separate IOFM usage from the other elements of Enhanced Recovery Pathways and variation in surgical and anaesthetic practice and caseloads between Trusts would complicate the picture.
- Ideas about content for the Trust questionnaire were discussed.

5.3: Project development

Following the project initiation meeting, the project support team supported by the clinical lead for the project produced the first draft of the Trust questionnaire and circulated it to the project reference group. In addition, the suggestion for a user survey was put to the group.

A teleconference was held on 5th November 2014. The project reference group agreed to the inclusion of the user survey in the project. The content of both the Trust questionnaire and user surveys were reviewed and clarifications and enhancements discussed.

Following the teleconference, a final draft of the question set was circulated to the project reference group and was subsequently finalised via e-mail and telephone discussions between the project support team and members of the reference group.

5.4: Data collection

Both the Trust survey and User survey opened for online data collection at the start of December. Trusts were given three months to collate the requested data and data collection closed at the end of February 2015.

To support Trusts participating in the project, site visits were arranged with each of the nine Trusts. Each site visit consisted of two members of the project support team visiting the Trust and meeting with anaesthetists, theatres nurses and informatics colleagues. The support team members provided the background to the project, answered queries about the processes and content and explored the local history of IOFM and views of the Trust and anaesthetists.

In January a peer-support teleconference was hosted by the project support team and chaired by the clinical lead, to give Trusts the opportunity to discuss any challenges they were facing in collating the data and to share solutions.

During the data collection period the project support team provided help desk support via phone and e-mail, providing definitional clarifications and advice on data collection. The responses to the user survey were monitored and individual Trusts were kept up-to-date with the number of responses from their Trust. The project support team and project leads worked together to maximise the number of responses received.

In parallel with the work on the Trust and User views, suppliers of IOFM equipment were contacted for telephone interviews. Suppliers were asked about their relationships with the NHS both nationally and regionally, how well they felt the NHS understood their business requirements and their views on the barriers to further adoption of the technology.

CCGs in the region were engaged by phone, e-mail and online surveys.

5.5: Analysis & reporting

Once the deadline had passed, the project support team validated and analysed the data. In cases where problems were found with the data the Trust Leads were contacted and the data discussed. Where required, revisions were accepted and incorporated into the analysis.

Draft findings of the user survey were presented at the National Theatres Conference held by the NHS Benchmarking Network at BMA House in London on the 19th March 2015.

A 33 page bespoke report was developed for each of the participating Trusts and circulated to the Trust leads. The reports provided a comprehensive analysis of the data collected including analysis of the Trust level data and the user survey data. Trusts were given the option of submitting any additional or amended data and revised reports were issued to Trusts in cases were new data or amendments were supplied.

The Project Findings Event was held on 30th April 2015 at the Magdalen Centre at Oxford Science Park. The meeting was attended by the project support team, anaesthetists and theatre nurses from the participating Trusts, academics from the University of Oxford and a representative from NHS England. The project support team facilitated a discussion of the results of the project and three of the Trust leads gave presentations about their own adoption of IOFM technology.

Following the Project Findings Event, the Trust Reports were finalised and circulated to Trusts. This document is the Project Summary Report and is the last reporting deliverable for this part of the Oxford AHSN IOFM project.

During the process, the project support team held regular meetings to ensure that the project kept to timetable and was in contact with participating Trusts via e-mail and phone so as to keep participants up-to-date with developments.

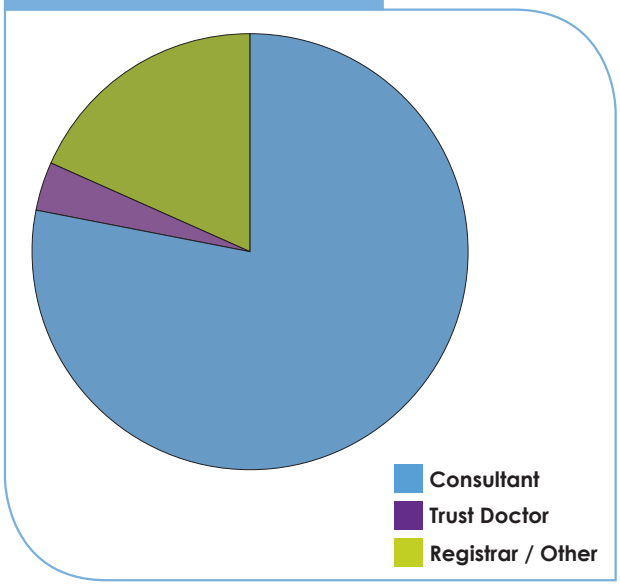
6: Participation and data quality

6.1: Participation

All eight Trusts from the Oxford AHSN region plus Central Manchester University Hospitals NHS Foundation Trust contributed data submissions to the project.

138 anaesthetists from the nine Trusts completed the user survey. This comprised 108 Consultants, 5 Trust doctors and 25 Registrars and other training grades. (See figure 6.1.1)

Fig 6.1.1: User survey respondents



6.2: Completeness of data

Many questions were completed by all participating Trusts, such as the stocktake of IOFM equipment. Detailed data around IOFM usage and finance is not routinely collected in the majority of Trusts and some questions, had lower response rates (around 50%). One key finding of the study is that Trusts' recording, coding and capacity to access and analyse data around IOFM usage and financing is currently limited.

The responses to the user survey had a high level of completeness.

6.3: Data validation

Trusts raised few definitional queries during the process and there were limited data problems. The project support team undertook a full validation of the data and unusual responses were identified and checked with the Trust leads.

Trusts were able to self-validate their responses using the draft Trust reports. The project support team accepted amendments throughout the process and the data was finalised a week after the regional Project Findings Event.

The data requested in the user survey was reviewed for anomalies and no problems were identified.

7: Project Findings

7.1: User perspective

Clinicians' opinions and preferences vary with regards to the best use and impact of the emerging IOFM technologies. An important requirement of this study was to gain a better understanding of clinicians' views and experiences as their expertise, first-hand experience and judgement will be a key factor in driving further appropriate adoption of the technology.

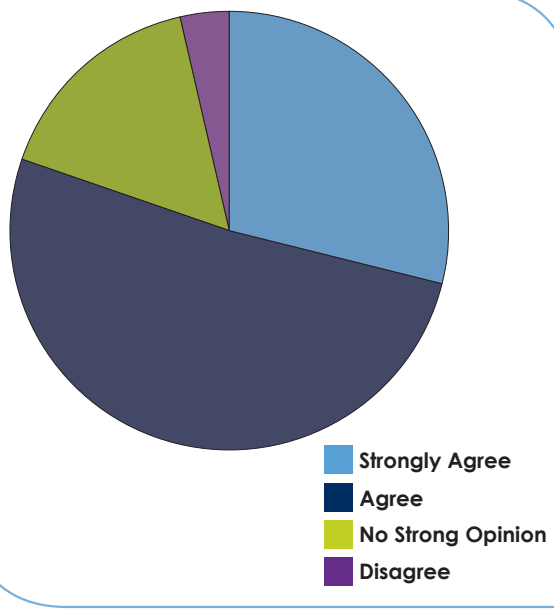
138 anaesthetists from the participating nine Trusts took part in the user survey. This is a significant number of users and provides a solid sample size to draw conclusions about the current opinions within participating Trusts.

Views on clinical value

Respondents were asked whether they 'saw a clinical value in IOFM' and the responses are set out in figure 7.1.1. 80% of respondents agreed or strongly agreed, 16% had no strong opinion and 4% disagreed. While this does not quantify the level of benefit, it shows a clear picture that the majority of clinicians view IOFM as having a role to play in improving patient outcomes.

Responses showed a small degree of variation by Trust with the most favourable Trust reporting a 50:50 split between strongly agree and agree, and the least favourable reporting a 50:50 split between agree and no strong opinion.

Fig 7.1.1: Do you see a clinical value in 'IOFM'



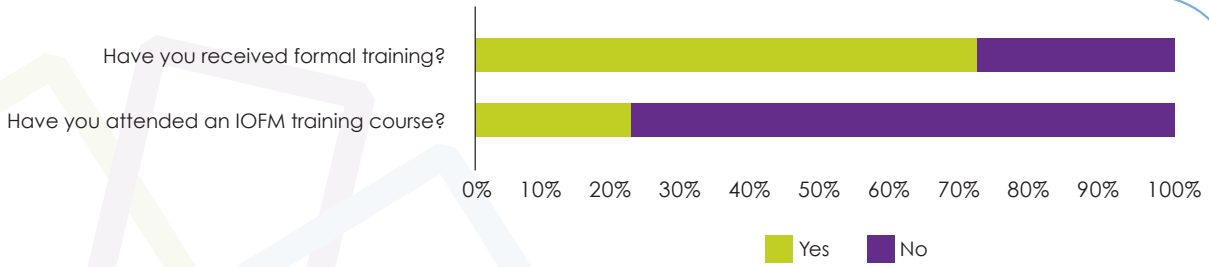
When the responses were compared on the basis of grade, the more junior anaesthetists were slightly more favourable than senior ones. No significant variation was found when the results were compared on the basis of training or number of years' experience of IOFM.

Training & Experience

Problems relating to insufficient training have been raised as a potential barrier to the appropriate use of IOFM. Figure 7.1.2 shows the responses to questions on whether the participants had received formal training in the use of IOFM and whether they had attended a training course.

The results show that 72% of respondents had received formal training and 23% had been on a training course. This shows a significant amount of training has been delivered, however not all users have received formal training. It would be interesting to further explore whether the majority of anaesthetists would like further training in the practical use of the equipment.

Fig 7.1.2: Training



Participants were also asked how many years they had been using IOFM technologies. Almost two thirds of respondents reported having used IOFM for 5 or more years.

Monitor preferences

Respondents were asked which monitors they preferred to use and why. The responses can be seen in figure 7.1.3. These responses match closely to the prevalence of monitors in the Trusts taking part in the study (see table 7.2.1). All monitors used in the region had at least one advocate.

Fig 7.1.3 - Monitor preferences

Monitor	Responses
Deltex Medical Ltd - CARDIOQ-ODM	38 (28%)
LiDCO Ltd - LiDCOrapid Hemodynamic Monitor	38 (28%)
Deltex Medical Ltd - CARDIOQ-ODM+	15 (11%)
LiDCO Ltd - LiDCOrapid Hemodynamic Monitor	10 (7%)
GE Anaesthesia Machines - SPV	6 (4%)
PROACT Medical Ltd - NICOM monitor	5 (4%)
Edwards Lifesciences - Vigileo Monitor	3 (2%)
Nihon Kohden UK Ltd - All Monitors	1 (1%)
Other	18 (13%)

The project reference group was interested to understand whether anaesthetists normally used only one type of monitor or whether they used different monitors depending on the type of procedure and patient. Figure 7.1.4 shows that 41% of respondents reported frequently using more than one type of monitor.

The balance of responses varied greatly between Trusts. As shown later in Figure 7.2.3, the number of different monitor types held by each Trust varies greatly and this was reflected in the response to this question; in one Trust all anaesthetists reported not using multiple monitors, while in another 67% responded that they frequently used more than one type.

IOFM strategy

IOFM equipment provides anaesthetists with readings/information; how they use this information to manage the patient's fluid status will vary dependent on factors such as procedure, patient and preferences of the individual anaesthetist. There are several different strategies with the aim of optimising fluid status. Respondents were asked how frequently they used five specific strategies and the responses are displayed in figure 7.1.5.

The results show that 'stroke volume optimisation' was the most frequently used with well over two thirds of respondents stating that they 'always' or 'frequently' applied it. 'Cardiac index/cardiac output' and 'minimisation of respiratory variation' came next and 'targeted values of delivered oxygen' was the least commonly used.

The appropriate use of IOFM strategies is an area that is likely to benefit from further study as the national discussion moves away from whether or not IOFM is being used, to how to optimise its use through adopting the best strategy given the specific circumstances of the operation.

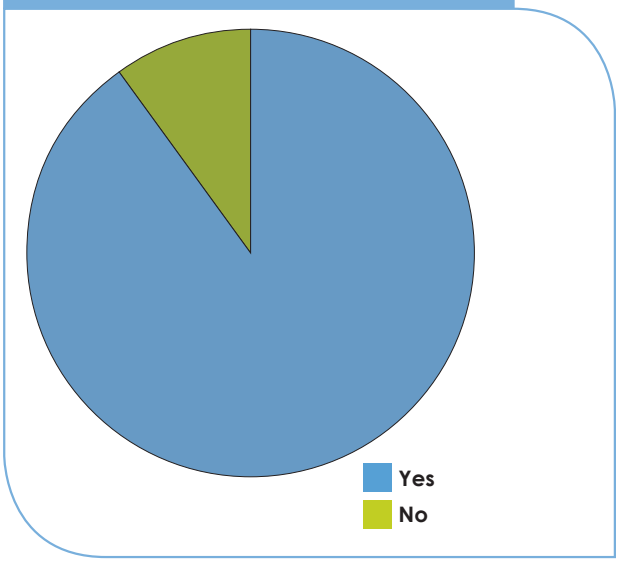
Fig 7.1.5 - IOFM strategy preferences

	Always	Frequently	Sometimes	Rarely	Never
Stroke volume optimisation	49	50	23	4	7
Minimisation of respiratory variation	13	36	29	26	22
Targeted values of delivered oxygen	2	11	17	39	47
Cardiac index/cardiac output	11	36	43	19	18
Prescribed 'fluid restriction'	3	18	29	31	36

Erroneous readings, serious incidents and other problems

83% of respondents reported having erroneous readings or other problems (figure 7.1.6). These included issues with calibration, interference and difficulties with siting of sensors and throat probes in/on patients as well as certain cohorts of patients with co-morbidities such as an arrhythmia or high BMI.

Fig 7.1.6 - Users who have experienced erroneous readings or other problems with IOFM equipment



In addition 2% of respondents reported having serious or untoward incidents relating to the administration of IOFM. Please note that serious incidents were not qualitatively collected for this project.

Change in practice since 2012/13

8Respondents were asked whether there were any surgical procedures where they would be more or less likely to use IOFM than in 2012/13. The majority of respondents answered no, however 26% responded that there were procedures where they would be more likely and 19% responded that there were procedures where they would be less likely.

Cohorts reported as more likely to be included: emergency laparotomy, free flaps, hip replacements and elderly/fragile patients.

The most common cases where anaesthetists reported being less likely to use IOFM related to low risk surgeries e.g. surgery with young fit patients or procedures that took a short length of time.

Feedback from users

Participants were invited to share any free comments they had with regards to IOFM. Examples are given for some of the key topics raised.

Training was raised as an issue:

- "Training on the job is not always appropriate and the lack of adequate training makes people use these devices as a tick-box exercise and not truly thinking about optimisation of a patient's fluid status."

Many anaesthetists are keen to see an **enhanced evidence base:**

- "We need a good quality prospective randomised control trial to assess whether IOFM actually makes a clinically significant difference."

Several comments related to the introduction of IOFM and **policies relating to the CQUIN** period:

- "Complex medicine cannot be delivered optimally by standardised inflexible protocols."
- "I think it inappropriate to be forced to use IOFM in situations where it is not clinically indicated e.g. 20 year old healthy man undergoing a laparotomy."

7.2: Trust perspective

Equipment stocktake

A key aim of the study was to determine what equipment was available to each Trusts and examine the variation between Trusts. As part of the Trust survey each Trust was asked which IOFM monitors they had available. All participating Trusts were able to provide this data and the summarised results are shown in Figure 7.2.1 and Figure 7.2.2.

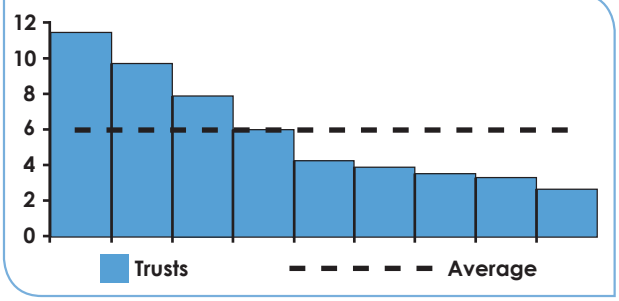
Fig 7.2.1 IOFM equipment stocktake

Deltex Medical Ltd - CARDIOQ-ODM	33
LiDCO Ltd - LiDCOrapid Hemodynamic Monitor	29
PROACT Medical Ltd - NICOM monitor	8
Deltex Medical Ltd - CARDIOQ-ODM+	7
LiDCO Ltd - LiDCOplus Hemodynamic Monitor	7
Edwards Lifesciences - Vigileo Monitor with FloTrac sensor	1
Nihon Kohden UK Ltd - All Monitors	1
Total	**86**

Deltex Medical Ltd's CardioQ-ODM and LiDCO Ltd.'s LiDCOrapid Hemodynamic Monitors were the most common monitors. Almost 90% of monitors used by participating Trusts were supplied by Deltex Medical Ltd or LiDCO Ltd.

Figure 7.2.3 compares the variation in numbers of monitors held by each Trust using the number of operating theatres as a denominator to adjust for the size of the Trusts.

Fig 7.2.3 - Number of monitors per 10 operating theatres, 31/3/14



This comparison shows a four-fold variation in the number of monitors available ranging from 2.8 monitors per ten theatres to 11 monitors per ten theatres.

On average Trusts held one monitor for every two theatres.

As well as looking at the numbers of monitors it is interesting to compare the number of different types available at each Trust. This is displayed in figure 7.2.4. On average each Trust had access to three different types of monitor however there was great variation between Trusts with one Trust using only one type and another Trust having access to six different types.

Fig 7.2.4 - Number of different monitors types held, 31/3/14

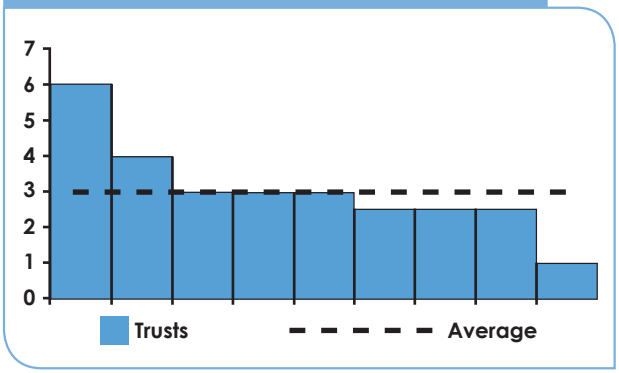
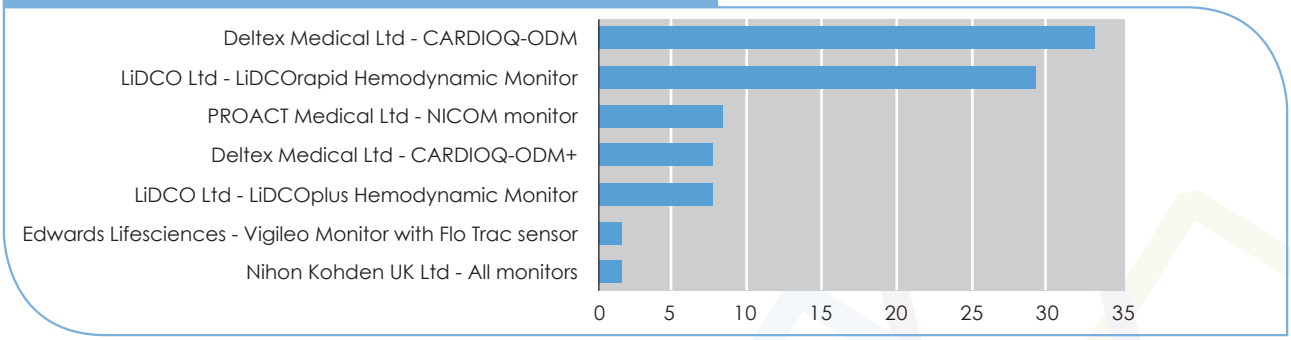


Fig 7.2.2: Number of monitors in participating Trusts, 31/3/14



Location of use

As well as being used in theatres many of these monitors can be used in other settings to monitor fluid status. Trusts were asked about their use in critical care, PACU/ Level 1 and other settings. All the participating Trusts use monitors in critical care, 57% used it in PACU/Level 1 and 17% in other locations.

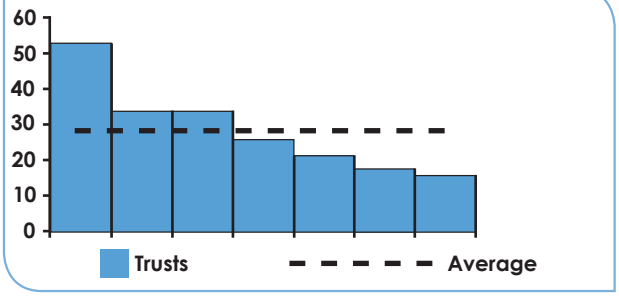
All of the monitor types used across the regional were used in theatres, but only the Deltex CardioQ-ODM and LiDCOrapid and LiDCOplus were used in critical care.

The LiDCOplus monitor was the only monitor type that was more frequently used in critical care than in theatres.

Overall usage in theatres

Participating Trusts were asked about the number of uses in theatres over a three year period (2011 to 2014). Figure 7.2.5 shows the variation in number of uses per theatre in 2013/14.

Fig 7.2.5 - Number of uses per theatre, 2013/14



On average there were 28 uses per theatre in 2013/14, ranging from 10 to 53 uses per theatre. These rates will be influenced both by the variation in types of procedures being carried out at each Trust and the approach to usage for individual procedures.

Of the six Trusts that were able to identify historical use, five showed an increase in usage over the time period, with four Trusts more than doubling their use. One Trust's level of use remained constant over the period reflecting their 'early adopter' status.

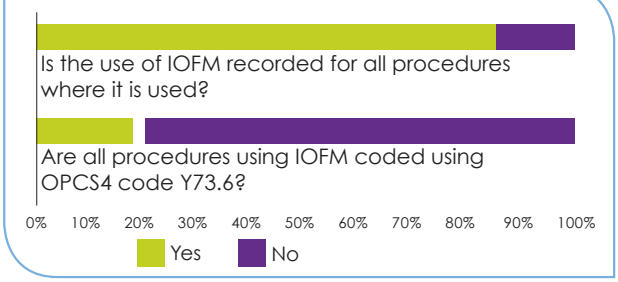
Recording use of IOFM

Consistent recording of IOFM usage is an important tool for individual Trusts to understand their practice across procedures and practitioners. This data can enable Trusts to develop their developmental priorities, identify training needs and make sure that suitable levels of disposables are being procured to meet demand.

Such data collection requires investment in both technology and staff time. Trusts also have the important immediate priorities of providing high quality patient care and making sure that theatre utilisation is as efficient as possible.

Trusts were asked about their recording of IOFM usage in theatres, see Figure 7.2.6.

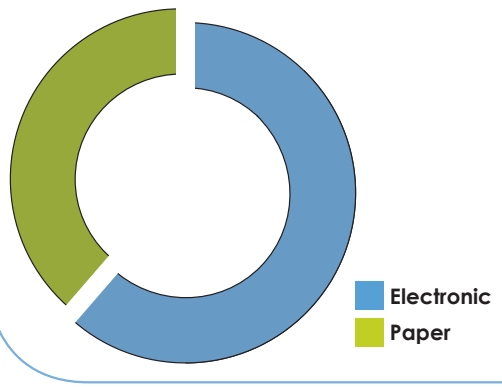
Fig 7.2.6 – Recording theatre usage of IOFM



86% of participating Trusts stated that the use of IOFM was recorded for all procedures where it is used. However only 20% coded this to the OPCS4 code created for this purpose.

Figure 7.2.7 shows that a third of Trusts were using paper based systems to record their IOFM usage.

Fig 7.2.7: Is use of IOFM recorded using an electronic or paper based system?



These findings indicate that progress is necessary for recording to become successfully integrated into the running of theatres.

This reflects the experiences of Trusts in collecting data for the ten week audit of usage (see later) where almost all participating Trusts reported initial problems in reporting data. Problems included:

1) Being able to consistently record use at the point of delivery

2) Being able to consistently code this information correctly

3) Being able to extract the data from the systems.

Review of standard practice

The 2013/14 CQUIN pre-qualifier used a list of 457 OPCS procedure codes from Appendix 3 of the NTAC IOFM Adoption Pack. These procedures were ones where it was viewed the implementation of the NICE guidelines for IOFM would be most applicable.

The project reference group was interested in seeing how IOFM usage varied across these procedures and to simplify the process the list was consolidated to 72 categories.

In addition three further procedures were added as the group wished to compare approaches taken by the different Trusts:

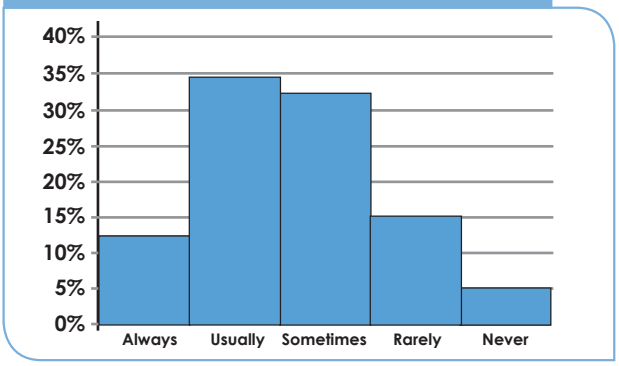
- Fractured neck of femur
- Emergency laparotomy
- Revision Hip Surgery

Each Trust was asked to judge their standard practice for each procedure that the Trust delivered on a scale of 'always', 'frequently', 'sometimes', 'rarely' and 'never'.

Figure 7.2.8 shows the frequency of responses for all Trusts and all procedures. This shows that the decision to use IOFM is not solely determined by procedure as the responses 'Always' and 'Never' are the two least frequent. Instead the responses 'usually', 'sometimes' and 'rarely' are more common showing that there is a more nuanced approach to usage.

This reflects the views from the user survey that IOFM usage should be based on clinical judgement rather than according to a prescribed procedure list.

Fig 7.2.8 - Summary of standard practice, all Trusts, all procedures



The most common response is 'usually', which indicates that IOFM is being used for a significant number of these procedures.

The full results by procedure are shown in figure 7.2.9 displayed on the next two pages.

The results show variation between procedures, for example, IOFM has high usage for 'Total excision of colon', but low usage for 'Instrumental correction of deformity of spine'.

In addition, variation between the practices of individual Trusts is evident, for example some Trusts always use IOFM for 'reconstruction of breast using abdominal flap', whilst others never use IOFM for this procedure.

Fig 7.2.9 - IOFM standard practice

Code	Procedure	Indicative usage	Always	Usually	Sometimes	Rarely	Never
J54	Transplantation of pancreas		1				
G27	Total excision of stomach		1	1	1		
J02	Partial excision of liver			1			
J04	Repair of liver			3			
J55	Total excision of pancreas			1			
J56	Excision of head of pancreas			1			
J57	Other partial excision of pancreas			1			
L28	Transluminal operations on aneurysmal segment of aorta		1		1		
M01	Transplantation of kidney			1			
M34	Total excision of bladder		1	2	1		
M61	Open excision of prostate			3			
ADD	Emergency laparotomy			6			
H04	Total excision of colon and rectum		1	4	2		
H05	Total exicision of colon14200		1	4	2		
H06	Extended excision of right hemicolon		1	4	2		
H33	Excision of rectum		1	4	2		
H198	Other open operations on colon		1	2	2		
ADD	Revision hip surgery		1	2	2		
G58	Excision of jejunum			3	1		
H07	Other excision of right hemicolon		1	4	1	1	
H08	Excision of transverse colon		1	4	1	1	
H09	Excision of left hemicolon		1	4	1	1	
H10	Excision of sigmoid colon		1	4	1	1	
G61	Bypass of jejunum			2	1		
G69	Excision of ileum		1	2	3		
H152	End colostomy - Other exteriorisation of colon		1	2	3		
L18	Emergency replacement of aneuysmal segment of aorta		1		2		
L19	Other replacement of aneurysmal segment of aorta		1		2		
L20	Other emergency bypass of segment of aorta		1		2		
L23	Plastic repair of aorta		1		2		
J70	Other excision of spleen			3	2		
H11	Other excision of colon		1	3	2	1	
G310	Conversion from previous anastomosis of stomach to duodenum			1	1		
G313	Revision of anastomosis of stomach to duodenum			1	1		
G314	Conversion to anastomosis of stomach to duodenum			1	1		
G320	Conversion from previous anastomosis to stomach to transposed jejunum			1	1		
G323	Conversion to anastomosis of stomach to transposed jejunum			1	1		

Code: This is the OPCS code for the group of procedures.
Procedure: The procedure list is a consolidated list from the CQUIN.
Indicative Usage: This metric has been generated from the number of responses given by individual Trusts, and has been used to rank the procedures from those where IOFM is most likely to be used to those where it is least likely to be used.
Always/Usually/Sometimes/Rarely/Never: These were the options Trusts could select to indicate their standard practice. The number shown is the number of Trusts who answered with that response.

Fig 7.2.9 - IOFM standard practice

Code	Procedure	Indicative usage	Always	Usually	Sometimes	Rarely	Never
G72	Other connection of ileum			3	3		
J69	Total excision of spleen			3	3		
L22	Attention to prosthesis of aorta		1			1	
H628	Other operations on bowel		1	2	2		1
L16	Extra-anatomic bypass of aorta		1		1	1	
L21	Other bypass of segment of aorta		1		1	1	
L252	Endarterectomy of aorta NEC - Other open operations on aorta		1		1	1	
L45	Reconstruction of other visceral branch of abdominal aorta		1		1	1	
L46	Other open operations on other visceral branch of abdominal aorta		1		1	1	
L48	Emergency replacement of aneurysmal iliac artery		1		1	1	
L49	Other replacement of aneurysmal iliac artery		1		1	1	
L50	Other emergency bypass of iliac artery		1		1	1	
L51	Other bypass of iliac artery		1		1	1	
L52	Reconstruction of iliac artery		1		1	1	
H122	Excision of lesion of colon NEC - Extirpation of lesion of colon			3	2	1	1
J03	Extirpation of lesion of liver				1		
J58	Extirpation of lesion of pancreas				1		
J59	Connection of pancreatic duct				1		
L56	Emergency replacement of aneurysmal femoral artery		1			2	
L58	Other emergency bypass of femoral artery		1			2	
M373	Repair of rupture of bladder – other repair of bladder			1	2	1	
X14	Clearance of pelvis			1		1	
T415	Other open operation on peritoneum			1	2	2	
B39	Reconstruction of breast using abdominal flap		1		1	1	1
Q071	Abdominal hysterocolpectomy and excision of periuterine tissue / uterus			1	2		1
M05	Open repair of kidney			1	2	1	1
M02	Total excision of kidney			1	2	2	1
J182	Total cholecystectomy and exploration of common bile duct / Excision of gallbladder				2	2	1
M03	Partial excision of kidney				2	2	1
ADD	Fractured neck of femur				3	1	2
J61	Open drainage of lesion of pancreas					1	
J63	Open examination of pancreas					1	
J65	Other open operations on pancreas					1	
M36	Enlargement of bladder				1	1	1
V41	Instrumental correction of deformity of spine				2	1	2
B38	Reconstruction of breast using flap of skin of buttock					1	1
J01	Transplantation of liver						
J60	Other open operations on pancreatic duct						

Procedures - this list was abbreviated from the CQUIN List.
Indicative usage. Used to order the procedures.

10 week audit of IOFM usage

The participating Trusts were asked to measure their IOFM usage over a ten week period against the procedure list discussed above.

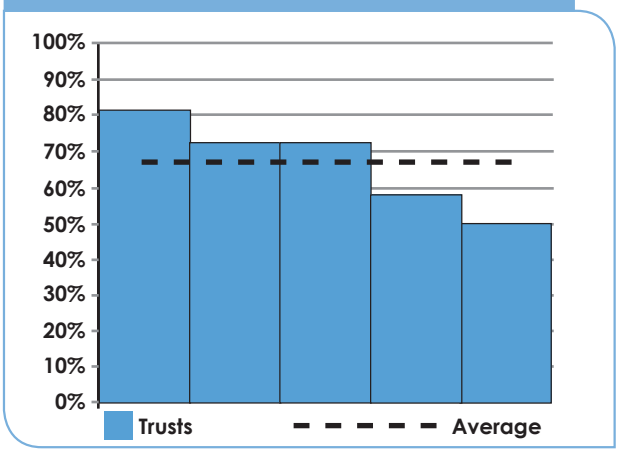
This was one of the most challenging aspects of the project with issues arising in the recording of usage, the correct coding of this information and the ability of Trusts to analyse and extract this data.

Only five of the Trusts were able to provide data for this element, which reflects the difficulty existing in obtaining accurate figures around the use of IOFM.

Headline usage rates

As explained above, this survey queried levels of usage based on the list of procedures in the CQUIN pre-qualifier. The pre-qualifier list was based on surgical procedures where IOFM was thought to potentially add value to patient care. The average usage rate for responding Trusts in this region was 67%. This value ranged from 50% to 83%. While four Trusts were unable to provide data, individual discussions with the project leads and the group discussion at the Findings Event suggested similar usage levels.

Fig 7.2.10 - % CQUIN list procedures in which IOFM was used during the 10 week sample



The average of 67% gives a positive picture of the technology becoming embedded within normal practice. This shows significant progress from the figure reported in the NHS document 'Innovation, Health and Wealth' which stated that in 2011 approximately 10% of relevant procedures included the use of IOFM monitors. It should be noted that the CQUIN pre-qualifier used an 80% target however, this was measured against a locally agreed subset of procedures and most Trusts achieved these locally set targets. The quantitative survey in the Oxford AHSN project used the full list without exclusions. The 67% stated usage rate is higher than had been anticipated.

Usage for the additional three procedures

As well as looking at the CQUIN list of procedures, participating Trusts were interested to examine IOFM usage over the three other procedures mentioned in the "standard practice" section.

- Emergency Laparotomy: All Trusts reported that their normal practice was to 'usually' use IOFM. Despite this, during the 10 week period only 35% of operations recorded in the region used IOFM (ranging from 0% to 84%) between Trusts.
- Revision Hip Surgery: 2 Trusts reported their standard practice as 'sometimes' using IOFM, 2 reported 'Usually' and one 'Always'. Insufficient data was collected during the ten week period to compare.
- Fractured neck of femur: Trusts reported low probability of using IOFM in their standard practice for fractured neck of femur. 3 Trusts reported 'sometimes', 1 'rarely', and 2 'never'. These responses matched the results of the ten week audit where only 3% of the 69 fractured neck of femur procedures recorded using IOFM.

Variation in usage by grade and type of procedure

The project reference group was interested to know whether the grade of anaesthetist, or the procedure being emergency or elective, had an impact on use of IOFM.

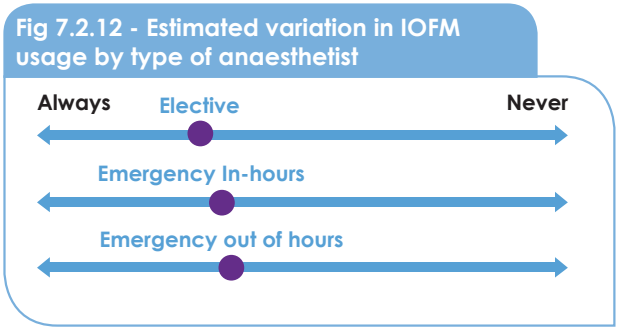
Participating Trusts were asked to rate the likelihood of IOFM use based on these criteria. The questions had responses of 'Never, Rarely, Sometimes, Usually and Always' and these were converted into numerical values to enable us to visualise these responses in figures 7.2.11 and 7.2.12. The circle represents an 'average' position for all responding Trusts.

Figure 7.2.11 shows that Trusts reported that senior anaesthetists are slightly more likely to use IOFM than junior colleagues. This slightly contrasts with the findings in Section 7.1 which showed that junior Doctors were more favourable to the clinical value of the technology then consultants. 'Usage' may reflect gaps in training of junior colleagues.

Fig 7.2.11 - Estimated variation in IOFM usage by grade of anaesthetist

Figure 7.2.12 shows that Trusts reported that IOFM is more likely to be used for Elective cases and that with emergency cases there is a slight drop off during out-of-hours.

Fig 7.2.12 - Estimated variation in IOFM usage by type of anaesthetist



Enhanced Recovery Pathway

As referenced in the introduction of this report, the Enhanced Recovery Programme is about improving patient outcomes and speeding up a patient's recovery after surgery, resulting in better outcomes and reduced length of stay.

Participants were asked if IOFM had been excluded from any enhanced recovery pathways used at the Trust. The only case where such an exclusion was reported, was when the IOFM monitors available would have entailed an additional invasive process and associated risks.

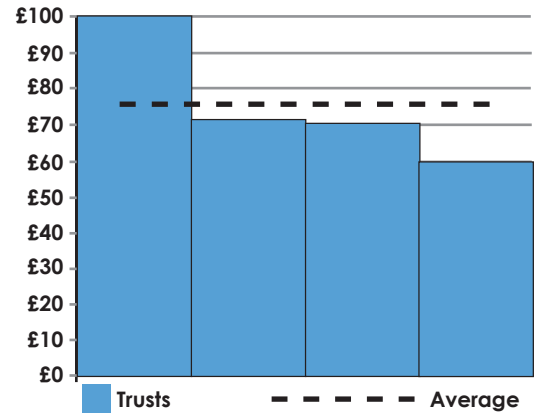
IOFM Finance

Trusts were asked about their expenditure on IOFM monitors and disposables, the asset value of their monitors and their plans for future investment.

Several participating Trusts had no asset value for the monitors due to arrangements where the monitors were either leased or provided for free with the cost to the suppliers being recuperated via the expenditure on disposables.

Collecting detailed financial information proved difficult. Four Trusts were able to provide details for their expenditure on monitors and disposables in 2013/14. This expenditure can be seen benchmarked per use of IOFM in figure 7.2.13. as an average cost of £75 per use.

Fig 7.2.13 - spend on disposables & monitors per use, 2013/14



NICE estimated savings of £493 per eligible patient calculated on the basis of reductions in average length of stay on High Dependency and Intensive Care units and Surgical Wards (see NICE template link in bibliography).

50% of participating Trusts reported that they had plans to invest in further IOFM equipment in 2015. This is being done via a range of funding approaches including paying for a year's supply of disposables up-front and in return the supplier providing upgraded machines free of charge, capital investment in new machines and purchasing being financed by the critical care budget.

Factors identified by Trusts as creating challenges for funding of the technology included the removal of the CQUIN pre-qualifier, tightening of budgets and difficulty in predicting usage of disposables.

A significant challenge that several Trusts reported facing in the past is that of silo budgeting. The cost of IOFM may sit within the theatres budget, while the benefit is seen elsewhere in terms of reduced length of stay and complications. Trusts need to take a strategic approach to ensure that utilisation is not limited by departmental budget saving pressures. In addition, by taking a Trust wide approach to IOFM there may be opportunities to maximise their buying power and ensure better value for money. This would align well with the present Carter Review Recommendations that highlights the benefits of coordinated procurement.

Effect of impact of CQUIN pre-qualifier

Trusts were asked about the impact that the introduction and removal of the CQUIN pre-qualifier had on their practice.

The impact was frequently shaped by the pre-existing use of IOFM in the Trust. Early adopters reported that the CQUIN pre-qualifier had minimal effect, while other Trusts reported that it was a useful tool to increase awareness and embed IOFM into their practice.

At the site visits clinicians reported some frustration among colleagues with the way the CQUIN pre-qualifiers had been managed. In some cases the financial incentives had been communicated better than the clinical benefits of IOFM. As a result some clinicians felt that the targets were driving them to prioritise financial imperatives ahead of their clinical judgement about what was best for the patient.

One Trust reported that the removal of the CQUIN…

"…has resulted in a significant reduction in use of IOFM as there is not global buy into the benefits of the technology".

All other Trusts reported that removal of the CQUIN pre-qualifier did not adversely affect the amount of use.

Ongoing and future plans for IOFM

Trusts were asked "does the Trust have any plans or policies for IOFM usage going forwards?"

Trusts replies are collated below:

- Trust 1: "No policies yet but the NELA (National Emergency Laparotomy Audit) audit that we are taking part in at the moment will guide us in to this. We have good experience of it in elective colorectal surgeries and we are extending its use in emergency laparotomies. Currently we do not realise the need for it in other areas and won't hesitate to use it if there is a need for it."
- Trust 2: "Continue with current use of Oesophageal Doppler, and consider non-invasive tools for patients under regional anaesthesia."
- Trust 3: "Plans for use in critical care. IOFM is to be included in pathways for major / high risk surgical patients e.g. Upper GI and Head & neck. Also 'Enhanced Recovery Plus' ERAS+ will have IOFM."
- Trust 4: "Having just converted to ODM plus there is a plan to continue cardiac output monitoring on incubated patients in ICU post laparotomy. Plan to review fractured neck of femur mortality, there may be a move to using/reviewing alternative methods of cardiac output monitoring for patients having spinal anaesthesia."
- Trust 5: "Yes - developing policy for routine use for emergency cases such as laparotomy, and all major elective cases (this needs full development and will follow national guidance). Considering routine usage for fractured neck of femur and revision hip surgery. Decision is still left with attending anaesthetist."
- Trust 6: "No - unless it is mandated."
- Trust 7: "Carry on as we are."

Findings event

On the 30th April 20 clinical and managerial delegates from the participating Trusts, the project support team and academia met at Oxford Science Park to discuss the results and share good practice. Delegates included consultant anaesthetists, theatre managers, researchers from the University of Oxford and the project support team. Some of the key discussion points were:

- It was felt that IOFM is beneficial when applied to many procedures and this is becoming the mainstream view.
- Many of the participants were following the journal publications around the evidence base for IOFM intently and it was agreed the complex multifactorial elements leading to measureable outcomes made it extremely difficult to draw definitive conclusions about the clinical benefits of IOFM.
- Evidence from the user survey and delegates' experiences suggested that anaesthetists are taking a more nuanced approach to the choice of whether to use IOFM. Anaesthetists were more likely to use IOFM for patients that were older, with co-morbidities and less likely to use them in younger healthier patients.
- The increased understanding and role of fluid management during the wider patient pathway was discussed. Patients are now less likely to arrive for theatre in a dehydrated state and there is increasing use of appointed Fluid Management Leads among anaesthetists and nurses.
- It was noted that different monitors were not all the same and should be viewed as 'different tools for different jobs.' This does not match the experiences from the user survey which reports that users normally use only one type of monitor.
- The role of the CQUIN pre-qualifier was discussed and participants felt that it was a blunt tool that raised awareness and provided a strong incentive for uptake, but was not always implemented sympathetically.
- There was discussion about evolving technologies, in particular the PPV/SPV (pulse/systolic pressure variation) analysis and newer monitors combining IOFM technologies.
- Most participants felt their Trust now had sufficient equipment and this was not a barrier to IOFM use however, one Trust has requested assistance with procurement of more devices.
- On reviewing the procedures examined in the project there was a consensus that IOFM should be used as standard practice for emergency laparotomies.
- An important idea raised was that discussions so far (including this study) have largely looked at whether IOFM equipment was being used or not. This is a simplistic approach and does not take into account how the anaesthetist is using the information received. In the future, discussions may need to revolve more around how to optimise the use of the data being received rather than just whether or not it is available.
- The two major barriers to adoption of technology discussed were (1) training and (2) silo budgeting resulting in unavailability of disposables or varying charges being applied.
    - o Training: delegates shared their experiences that lack of training could be a significant barrier to utilisation of the equipment, especially during initial uptake of the technology.
    - o The benefits of use of IOFM are to the Trust (e.g. lower LOS, better outcomes, lower complications) while the cost is frequently borne by the Theatres' budget, dis-incentivising investment. Breaking down this silo budgeting is important for sustainable usage. An example was given where in one Trust, four different theatre sites were paying four different rates for the same disposable. This shows the importance of Trusts taking a co-ordinated approach to procurement.

7.3: Supplier perspective

The project support team interviewed supplier organisations of Intraoperative Fluid Management Technology. The purpose of the interviews was to gain opinions from a cross-section of suppliers on barriers to adoption within the NHS.

There were four main areas of questioning;

- Relationships between suppliers and the NHS
- Perception of NHS understanding of supplier operations
- Views on governing quality between NHS and Suppliers
- Barriers to adoption

Views on suppliers relationships with the NHS (locally and nationally)

The majority of suppliers believed that relationships with the NHS were difficult. This was in part due to the difficulty for suppliers to speak directly to clinicians and showcase their innovations.

Another factor raised was the financial pressures within NHS organisations. There is a general perception from suppliers that NHS organisations' procurement departments are acting as gatekeepers and focusing on cost savings rather than value for money or spend to save. If the innovations required up-front costs to generate future savings, there is a barrier created between the supplier and the NHS.

The CQUIN pre-qualifier, which was not available in the 2014/15, was also raised as creating a barrier as Trusts did not develop an ongoing plan for financing IOFM. Suppliers reported NHS clinicians have vented frustrations at the lack of alternative funding routes for IOFM.

Suppliers perceived that focus had reduced since the original Innovation, Health and Wealth policy was published.

One supplier reported that they had good relationships with the NHS as customers. This organisation reported working with the NHS on premarket release and an enhanced focus on looking for feedback on devices.

Views on NHS understanding of supplier operations

There were mixed experiences from the suppliers interviewed. Some suppliers felt that there was a lack of understanding across all levels of the NHS from policy makers to operational management as to the benefits of using IOFM. Other suppliers felt there was better understanding developing over time.

Some suppliers reported that there was no way of promoting new products into the NHS and it was difficult to take forward new innovations and to trial products. It was acknowledged that this varied across the country and in some areas it was easier than others.

One supplier commented on the short notice requests from hospital theatre departments for kit to be delivered the same day. This supplier had a number of experiences where theatre departments had requested kit to be delivered within an hour as a patient was due to have an operation – something that was not physically possible.

How quality is audited and inspected between Supplier and NHS Trusts

Suppliers provided information on the annual auditing and certification process to ensure high level of quality in products and services.

Suppliers conduct internal audits with Trusts on a regular basis, and constantly feedback complaints to the manufacturers.

All suppliers commented that if an issue is raised by an NHS Trust, this is discussed internally and appropriate reviews are undertaken. Quality issues are discussed on a regular basis.

Views on perceived adoption of technology barriers

All suppliers shared the view that NHS budgets are a major barrier to the adoption of technology. All suppliers reported that clinicians had informed them there is no money to buy devices.

There is a perception shared by suppliers that 'up-front' cost savings are valued more than 'invest to save' initiatives.

Other barriers mentioned included NHS Trusts not routinely collecting robust information on IOFM usage or tracking patient outcomes with regards to IOFM, which meant Trusts were unable to identify requirements and present business cases.

Ceasing the CQUIN pre-qualifier was also highlighted as a barrier to adoption. This removed a source of funding for IOFM and suppliers reported that many NHS Trusts then had a reduced focus on IOFM.

Suppliers reported that there was a lack of understanding from contracting managers (at both providers and commissioners) that different technologies support different clinical interventions and IOFM technologies cannot be classed as a 'one size fits all' solution.

Procurement was raised as a barrier to adoption, with suppliers commenting that procurement routes were too lengthy and often acted as a barrier preventing access to clinicians.

One supplier commented that there seemed to be no system within the NHS for NHS Trusts to find all the companies that supply IOFM technology. There was a perception that sometimes suppliers are chosen without the purchasing body reviewing all the options.

One supplier commented that when suppliers visit hospitals to demonstrate products, they often do not showcase to decision-makers and this can slow down the adoption process.

One supplier commented that clinicians had reported they have a quota for IOFM consumables per month, but consumable capacity is not calculated against potential demand. Therefore clinicians have reported to suppliers that they cannot always use the technology for all eligible patients and equipment is left on shelves when the budget for consumables has been exhausted.

7.4: Commissioner Perspective & NHS England

An aim of the project was to understand how commissioning bodies within the NHS view IOFM technology, its usage and their role in the adoption process.

NHSE and local Commissioners were asked to comment on what was known about IOFM technologies.

NHS England

NHS England has taken a number of steps to improve the uptake of technologies within the NHS. These include:

- In 2011 IOFM was identified as one of six 'High Impact Innovations' by the then NHS Institute for Innovation and Improvement. This was subsequently published and promoted in 'Innovation, Health and Wealth'.
- The 2012 Commissioning for Quality and Innovation 2013/14, included guidance for IOFM and most Trusts adopted this as a local CQUIN.
- So as to support data collection, an OPCS code was developed to record Hospital Episodic Statistics data on IOFM.
- Further support for adoption has come via the establishment of the Academic Health Science Networks who actively support clinical innovations such as IOFM.
- Cardiac Output Monitoring, which includes IOFM, is now recorded in the Quarterly Innovation Scorecard, published by the HSCIC.

Clinical Commissioning Groups

CCGs were engaged through e-mail, telephone and online surveys. CCGs reported that their knowledge of IOFM was primarily through the 2013/14 CQUIN pre-qualifier and role of IOFM within the Enhanced Recovery Programme.

CQUINs are an important tool for incentivising Trusts to deliver on quality and innovation. During 2013/14 the CCGs worked with their Acute Trusts to support the uptake and spread of IOFM, in line with local commissioning strategies. During the site visits Trusts reported that CCGs showed flexibility in agreeing the criteria to be measured for the pre-qualifier making sure the approach was suitable for local adoption.

Ongoing monitoring of uptake and usage should be done through the Service Development and Implementation Plans (SDIP) included in the NHS Contract held between CCGs and Acute Trusts.

The study found no evidence that any CCG in the Oxford AHSN region had incorporated IOFM adoption into the 2014/15 Acute Trust contracts and this view was shared by the Trust representatives at the regional Findings Event.

The CCGs surveyed said that they were willing to work with Acute Trusts to resolve barriers to adoption where they exist locally. CCGs also expressed the view that the best driver for further IOFM adoption is the ability to demonstrate a correlation between good clinical outcomes and IOFM usage.

8: Key Areas and Recommendations

The purpose for doing the benchmarking exercise was agreed as being to "increase the relevant adoption of Intraoperative Fluid Management Technology across the region".

The main barriers that have hindered adoption are:

Barriers	Description
Evidence challenges	Unawareness of the evidence.
Lack of IOFM provider and commissioner policies	IOFM policies have not been set up by Commissioners or Providers founded on evidence based benefits of using IOFM technologies with specific procedures and in certain circumstances such as high dependency or critical care units.
Training	Anaesthetists not having access to on the job training or scheduled training.
Availability of funds	Issues with ongoing purchase of disposables. Issues with procurement of new equipment.

Addressing the above barriers should increase the relevant adoption of IOFM.

The objectives of this project that were agreed and delivered were as follows:

Objectives	Project Delivered?
To better understand the views and experiences of IOFM of anaesthetists at participating Trusts	✓
To provide feedback to NHS England to inform future national policy	✓
To understand the barriers to adoption from the perspective of users, NHS Providers, NHS Commissioners and Industry.	✓
To design and develop tools that providers and commissioners can use to inform business planning, service development and contract management.	Ongoing

Further joint working is required with the providers and commissioners to fully deliver Objective #4.

Key Areas that emerged from this project were:

1. Application of the technology – IOFM Policies

Whilst many clinicians practise and see the value in using IOFM technologies, the adoption of it is nuanced by a number of factors including patients' condition, procedure type and appropriateness/availability of the IOFM technology to be used. IOFM policies are required to support consistent and appropriate use of the technologies.

2. IOFM Benefits and their Realisation

One of the key challenges that was repeatedly mentioned during this study was the lack of robust evidence to substantiate the benefits of using the technology.

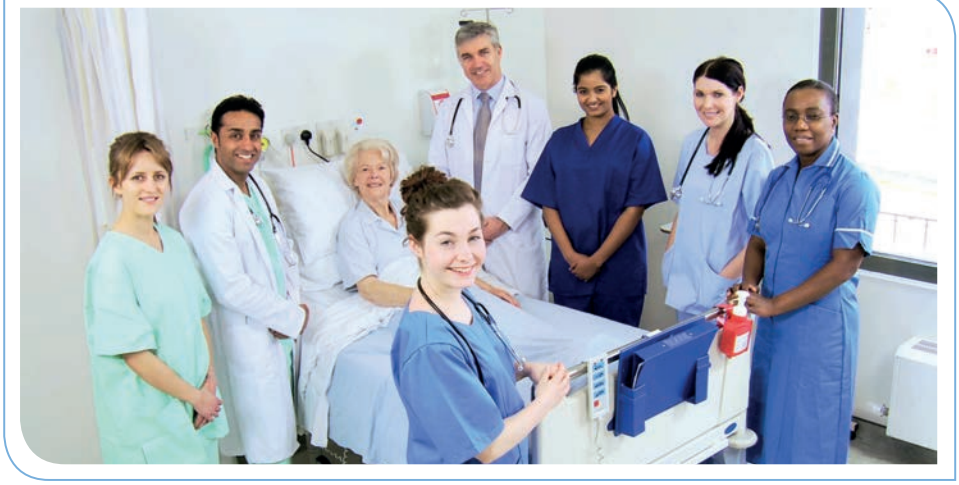
The benefits of IOFM technology used for specific procedures and its' role in the Enhanced Recovery Pathway has been recognised with some strong evidenced based research highlighting benefits such as improved recovery time, reduced pain and reduced Length of Stay.

Observations made by clinicians in this study about some of the procedures that they use IOFM technology with, has been substantiated by published robust research and evaluation; other procedures require further research or robust evaluation to demonstrate the benefit.

The project also found that published evidence is often not known to clinicians and Senior Managers. This often leads to 'redlining' disposables required for IOFM monitors to be used and missed opportunities for system efficiencies such as reduction in length of stay.

3. Training

Within the Oxford AHSN region there are approximately 700 anaesthetists of which the ratio of junior doctors to consultants is in the region of 3 to 1. Junior anaesthetists expressed an interest in learning how to use IOFM technologies and the lack of opportunity to train/use the monitors. It may be beneficial to explore whether anaesthetists in general would like further training with different monitors.



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Based on the key areas that have emerged from this project, we make the following recommendations:

Recommendation #1 – Application of the Technology – IOFM Policies:

Developing appropriate IOFM policies will benefit from further study as the discussion moves away from whether or not IOFM is being used, to how to optimise its use.

For those procedures where there is evidenced-based opinion that IOFM is of benefit such as gastrointestinal surgery, laparotomy and emergency laparotomy, Trusts should look to embed this into their normal contract.

To enable this, Trusts should implement a clear policy with regards to procurement and financing so as to harness purchasing power and to reduce the likelihood of silo budgeting decisions – focus should be on value for money and spend to save rather than just cost. High-level support at Trusts is important to drive business cases and ensure suitable priority in the procurement process.

Recommendation #2 – IOFM Benefits and their realisation:

One of the key challenges that was repeatedly mentioned during this study was the "lack of robust evidence" to substantiate the benefits of using the technology.

This report mentions a number of procedures that anaesthetists use IOFM for and that the literature research undertaken revealed that a limited number of research and evaluation projects have been conducted worldwide that prove the benefits of IOFM for certain procedures. Communication of this to clinicians and managers may drive up utilisation.

This finding also increases the importance of collecting local data and information to gain further insight into how patients may benefit.

Trusts should seek to improve and integrate the collection, recording, coding and analysis of data so as to improve decision making and to develop plans. Ideally, data on IOFM should be collected and made available internally and externally for the purpose of anonymised evaluation. This may encourage a wider list of procedures to become part of mainstream IOFM planning.

Recommendation #3 – Training:

Sustainable Improvement to the health system is reliant on Consultants and Junior Doctors being encouraged to adopt new ways of working and having the opportunity to train on these new technologies where the benchmarking process shows definite benefits.

A training programme/s could be developed and implemented for clinicians. This may be in the form of job training and/or formalised opportunities to train either from experienced colleagues or/and suppliers.

Recommendation #4 – Further Research:

It may be of interest to research bodies such as the CLARHC (Collaboration for Leadership in Applied Health Research and Care) to work on studies with the NHS on IOFM linked to specific procedures such as colorectal, gynaecology, orthopaedic, and urology as these are key areas where the Enhanced Recovery Programme has already demonstrated benefit. This study also gathered quantitative data from anaesthetists as to their usage. Other procedures where IOFM is being regularly used included 'total excision of pancreas' and 'spleen' and 'open excision of prostate' even though at the moment there is limited research evidence to support this. Further research and evidence gathering would strengthen 'in practise' usage and encourage increased levels of adoption.

9: Next Steps

Steps required by Oxford AHSN to support delivery of the recommendations include:

- *Sharing evidence based procedures with Providers and Commissioners.*

This includes literature reviews that were conducted during the project. There may be interest in monitoring usage for evidence based procedures. Measures may include base lining information on the number of these procedures taking place and then monitoring IOFM usage through the OPCS code.

- *Identify other procedures from this report that have been highlighted by clinicians as being potentially 'beneficial' and consider piloting for uptake and evaluation at Trusts in the region.*
  - o Agreeing on metrics to enable us to determine whether we do get better outcomes.
  - o Evaluation could include patient experience of recovery, length of stay, levels of pain during recovery.
  - o Align with objectives of the National Emergency Laparotomy Audit (NELA) due to be completed in October - and which asks whether IOFM monitoring is used for this procedure.
- *Making contact with clinicians to find out if they are interested in training.*
  - o This could include working with suppliers to determine whether they conduct regular training programmes.
  - o Training support may require us to explore funding and options could be explored.
- *Sharing published IOFM summary report and case study with NHSE*
  - o Enquire about potential funding routes for pump priming delivery of the above training and required additional IOFM monitors.
  - o Share published summary report and case study with NHSE for national distribution.
- *Work with providers and commissioners to develop/ design appropriate tools*
  - o Business plans, service development tools and contract deliverables could be created from evidence based research for use by the providers and commissioners.

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Academic Health
Science Network

www.oxfordahsn.org

Magdalen Centre North,
1 Robert Robinson Avenue, Oxford Science Park, OX4 4GA, United Kingdom

t: +44(0)1865 784944 **e:** info@oxfordahsn.org

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