Final report

February 2017

Innovating for Improvement

Optimisation of adrenal incidentaloma patient management pathway using a novel IT Management System

University Hospital of North Midlands

The Health Foundation

About the project

Project title: Optimisation of adrenal incidentaloma patient management pathway using a novel IT Management System

Lead organisation: University Hospital of North Midlands

Partner organisation: University Hospital of South Manchester

Project lead/s:

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Part 1: Abstract

Context

Adrenal incidentalomas (AI) are lesions which are increasingly found while patients are undergoing radiological scans for other conditions. This equates to around 500 patients per year at a typical teaching hospital. While most are benign and hormonally non-functional, around 20% are malignant and/or produce excess hormones (hormonally-active). Malignant lesions require rapid treatment as tumours can be aggressive and life-threatening. Hormonally-active tumours may result in the development of a number of endocrine disorders, which can cause significant morbidity and mortality.

The extent and approach to the investigation and follow-up of AIs is variable, and there is no robust evidence for their management. Studies have shown that most patients receive no biochemical investigation or follow-up.

This project, based at two acute hospitals, aimed to establish more effective management of patients with AIs, minimise delays in diagnosis/treatment, and reduce patient distress.

Innovation

This included four components:

1. We developed a prioritisation strategy, in collaboration with MDT members, which ensures that high risk individuals are prioritised for detailed prompt discussion and management decision.

2. In collaboration with Trust IT colleagues, we developed a web-based embedded electronic management system (the electronic Adrenal Incidentaloma Management System; “eAIMS”). This captures the key information on all AI cases and generates a pre-populated outcome letter, thereby saving both clinical and administrative time and effort whilst ensuring timely management plan with enhanced safety (reduced need to re-dictate and type results, minimising transcription errors). The system is aligned with the newly published European Guidelines for AI.

3. We gauged patient views in focus groups discussions. This informed the process-mapping and the re-design of the MDT process. It also resulted in the development of a patient information leaflet.

4. Built-in the project is the partnership with UHSM to maximise the generalizability and utility of the system. The system was conceived as web-based from the outset to facilitate wider adoption. We have also established dialogue with the Association of British Clinical Diabetologists to showcase our work to other centres (potential system users).

Implementation

1. We adopted the new 2016 European guidelines as up-to-date, evidence-based and NHS-aligned.

2. We developed the eAIMS system, including (i) initial conceptualisation, involving discussion amongst key stakeholders, (ii) translation of the concepts into the system specification, based on process mapping, (iii) conversion of the specification into an initial prototype, by an iterative process, (iv) we ensuring compliance with appropriate information governance framework, (v) subsequent initiation and completion a comprehensive and rigorous testing protocol, (vi) testin the system with real patient data. At that stage, it became clear that an outcome letter would be key to facilitating system scale-up and wider adoption, (vii) finally, system implementation with real-patient data (currently has over 100 records).

3. We gauged patient views through focus group discussions. This allowed us to develop a patient information leaflet. These discussions also informed the process mapping, including the appropriate timing for follow-up arrangement to minimise anxiety.

Outcomes & impact

1. Using newly published European guidelines, we developed a novel, web-based eAIMS that links the clinical, biochemical and radiological data necessary for assessing and managing AI patients.

2. Implementation of eAIMS, along with improvements in the prioritisation strategy, resulted in:

    a. A **78% reduction in the time from AI identification to MDT decision** (vs. our original primary objective of 20%!). This significantly reduced delay will result in less patient anxiety.

    b. A **49% reduction in staff hand-on time**.

    c. **Improved patient safety**:

        i. A **reduction in the risk of transcription errors**, given the in-built error validation of entered data and the automatic generation of the MDT outcome letter as opposed to repeated human-instigated steps.

        ii. Our analysis identified that 70% of AIs were not being followed-up, and hence we are now developing the next stage of the programme to proactively identify all new AI cases, thereby **avoiding missing cases** (work in progress).

    d. A **28% reduction in costs** (from an independent health economics analysis).

Challenges

1. We did not develop consensus guideline as this became redundant following publication of new 2016 guidelines.

2. We had to accept manual entry of results within the limited budget of this pilot work and to enable the system to be web-based.

3. We rapidly identified the importance of incorporating an MDT outcome letter into eAIMS, within the existing budget, to save time and reduce errors. Ultimately, this will positively impact on uptake by other centres.

Learning

The development of eAIMS enabled by:

1. Supportive HF Management Consultant, highlighting the benefits of the HF approach in support rather than supervision.

2. Honest and engaged IT Manager who quickly identified the optimum way to develop the system and invested considerable time in project oversight.

3. Supportive IT programmer who grasped the concepts early and rapidly implemented changes. He continues to support after concluding his work officially.

4. Dedicated and diligent MDT co-ordinator who assisted with the time & motion studies and embraced the clinical implementation of eAIMS.

5. Shared vision, with colleagues at UHSM, of a web-based system that could be scaled into a national solution from the outset.

6. Invaluable patient engagement event that provided critical insight on the degree of anxiety involved, assisted in the patient leaflet development and informed the design of the new pathway.

Part 2: Progress and outcomes

Course of intervention

1. Re-design the Adrenal Incidentaloma (AI) pathway: We developed a prioritisation strategy to, in collaboration with radiology and biochemistry MDT members. This ensured that high risk individuals are prioritised for detailed prompt discussions, whilst streamlining the process for low risk cases

2. Development of the electronic Adrenal Incidentaloma Management System (eAIMS): In collaboration with IT, we developed a web-based embedded electronic management system. This captures the key information on all AI cases and generates a pre-populated outcome letter, thereby saving both clinical and administrative time and effort whilst ensuring timely management plan with enhanced safety (reduced need to re-dictate and type results minimising transcription errors). The system is aligned with the newly published European Guidelines for AI.

3. We have gauged patient views who informed the process-mapping and the re-design of the MDT process to address the concerns expressed in our focus group discussions. Also developed an information leaflet

4. Links outside UHNM: Built-in the project is the partnership with UHSM to explore the generalizability and utility of the system. The system was conceived as web-based from the outset to facilitate wider adoption. We have also established dialogue with the Association of British Clinical Diabetologists to showcase our work.

Primary and secondary data

Initially, the time from initial radiological detection to MDT decision was our primary outcome. However, whilst we were developing the eAIMS system, we had to accommodate rising numbers of largely low-risk cases whilst promptly handling the urgent complex cases. Therefore, we upgraded our processes to include clinical prioritisation for MDT case selection. This meant that we exceed our target to speeding up the process even before the eAIMS system was implemented. Hence, while we will present data on the impact of these improvements, we will also focus of the benefits of the system in terms of safety, efficiency and cost-effectiveness, as follows:

1. Safety: The proportion of patients currently being missed (identified by radiology with AI, but not referred for further evaluation). Using key terms, a database was created of CT scans with AIs. A consultant radiologist (Dr Cherian George) and Prof Hanna reviewed the radiological and clinical data to identify those with genuine AI and the proportion referred for further evaluation. Based on expected prevalence data, our hypothesis has been that most patients are missed.
2. Efficiency: The time taken, in terms of hands-on time, to process each case. This was estimated based on discussion with the key staff who perform each step (secretary, endocrinologist, biochemist, radiologist, MDT staff).

3. Cost-effectiveness: The above data were independently assessed by a health economist (Prof Ric Fordham; identified via a Health Foundation webinar).

Patient-centredness: through the above, this will be largely achieved. In addition, the patient focus group facilitated the development of a patient information leaflet.

Balancing measures: As a result of the project, the team evolved so that one band 4 secretary focused on managing the eAIMS system as an MDT coordinator, thereby maximising the benefit from the system.

Results

1. eAIMS System Development: Delivering the system with built-in MDT outcome letter: We successfully developed eAIMS, including:

    a. Conceptualisation: Discussion amongst key stakeholders to agree the board parameters and system deliverables.

    b. Specification development (with IT collaboration): Based on process mapping (see Appendix 1.1) and discussion with our IT colleagues, we translated the concepts into the system specification document required for all Trust IT projects.

    c. Prototype development: The assigned IT programmer (Chris Hale) translated the specification into an initial prototype, which then went through several iterations based on on-going discussions with the project team (see mid-term report for initial screenshots).

    d. Information governance compliance assessment: As an integral part to ensuring Information governance requirements were fulfilled, especially given the web-based nature of the product, we linked with the Trust IG team to complete the necessary steps to ensure compliance.

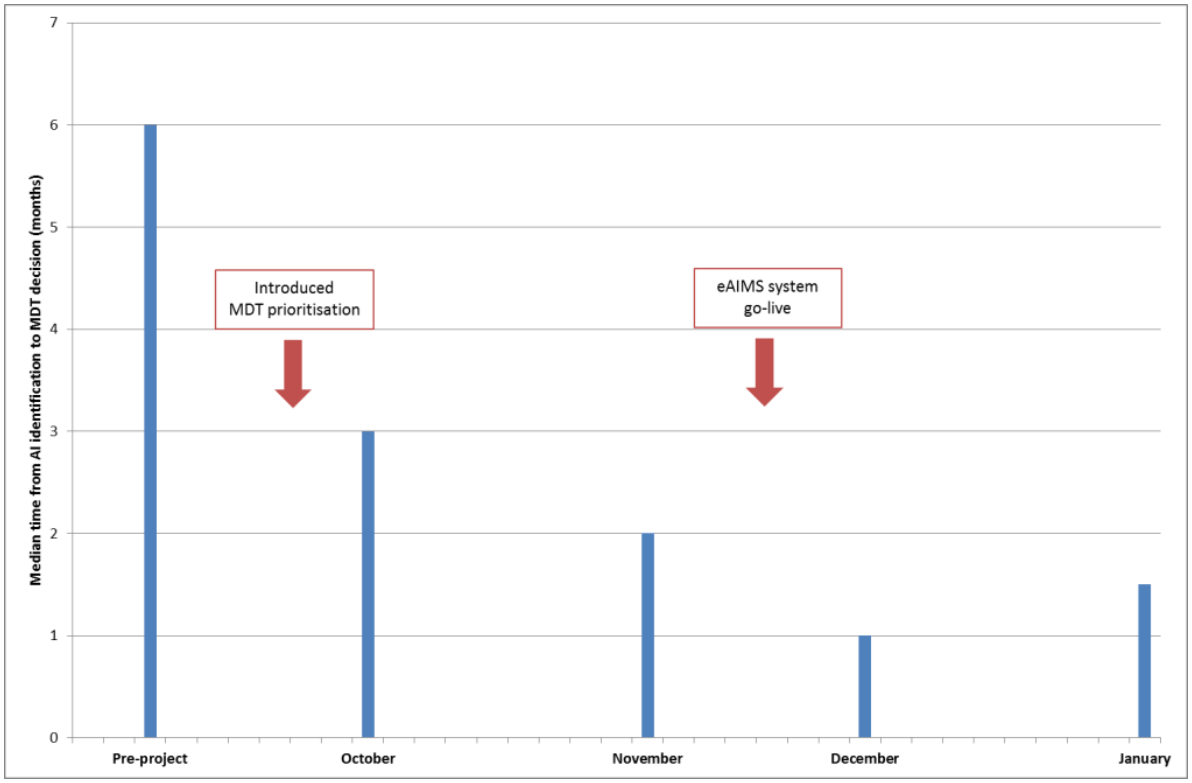
    e. System check and de-bugging: Following the development of the initial prototype, our IT colleagues initiated and completed a comprehensive and rigorous testing protocol, using a series of testing scripts based on clinically-relevant scenarios, to ensure optimum system performance, as per all Trust-developed IT initiatives.

    f. System testing and revision: After completing IT-instigated assessments, we started to test the system with real patient data. This enabled us to identify areas for improvement of data entry. This included the key step of generating an MDT outcome letter (see Appendix 1.2), thereby enhancing the potential of the system to be scaled up and adopted at other centres.

    g. Implementation. The system was implemented with real-patient data and currently has over 100 records. A demonstration (with fictional patients) is available from the following link: http://mi.cx/eaims-phase1-demo.mp4.

2. Shortened patient journey

Our initial objective was to reduce the delay between AI identification and MDR decision from the pre-project 6 months by 20% to 4.8 months. As a result of this project, we have observed a stepwise reduction in this delay as different elements of the programme were instigated. For example, introduction of the improved prioritisation of cases within MDT resulted in the median delay being reduced to 2.5 months (58% reduction), while implementation of the eAIMS system reduced this further to 1.3 months (**78% reduction in delay**). See figure below:



3. <u>Enhanced safety</u>

We collected data on adrenal lesions reported on CT scans:

a. We used the following phrases: Adrenal adenoma, Adrenal incidentaloma, Adrenal lesion, Adrenal mass, Adrenal nodule, Incidental adrenal, Indeterminate adrenal.
b. We collected data starting 2014 (choosing one month [November] per year as a representative sample)
c. Patients with known cancer were excluded and those with genuine AIs were then checked (based on MDT note entry and/or review of endocrinology letters) to confirm whether they were acted upon and being referred to endocrinology for further assessment or not.
d. Data is summarised in the table below:

	Nov 2014	Nov 2015	Nov 2016
Total cases reported using	57	76	77

the index phrases			
Previously known malignancies (excluded)	30	41	15
Confirmed AIs	27	35	62
AIs referred	8	10	20
Percentage of AIs referred	29.6%	28.6%	32.3%

Analysis showed that, despite having a dedicated MDT and service, which is not the routine practice in most centres in the UK and globally, only ~30% of cases are referred for evaluation. This means that, even in our hands with a dedicated team and spreading knowledge, **70% of AIs are being missed.**

Our eAIMS will enable us to detect all those to highlight to the GPs and if they wish, we will process them efficiently through our streamlined process and electronic system.

4. Increased efficiency (cost per case)

    a. We collaborated with Health Economist, Prof Ric Fordham's team at the University of East Anglia, who independently assessed the data.

    b. We provided data on a time & motion assessment of the hands-on time of each step from referral to MDT decision. This was obtained at three stages:

        i. prior to the project

        ii. following eAIMS go-live + MDT prioritisation

        iii. pro-active AI identification (post-project phase currently being implemented)

    c. A Gantt chart illustrating the impact of these phases is shown in Appendix 1.3. Briefly, this showed that the estimated cumulative time taken for progressing each case was:

        i. Phase 1 (pre-project): 168 mins

        ii. Phase 2 (eAIMS+prioritisation): 115 mins

        iii. Phase 3 (proactive AI detection+case streamlining: 66 mins

    d. Prof Fordham then evaluated the cost impact of this phased change utilising standardised staff costs.

    e. His team developed a novel Adrenal Incidentaloma Intervention Cost Assessment tool (AI_2CAT) (see Appendix 1.4 for full report).

    f. In conclusion, their analysis showed that the combination of MDT prioritisation process a and introducing the eAIMS system (phase 2)

significantly reduced:

i. The number of steps/tasks

ii. The total time taken by 48.6%

iii. The total costs by 28.2%

g. These improvements are likely to be further enhanced with further streamlining in phase 3

5. Patient leaflet

As a result of the focus group discussions, we developed a simple patient leaflet (see Appendix 1.5). We intend to hold further focus groups on both sites to review this and include frequently asked questions. These will be uploaded onto eAIMS on a patient accessible section for online support.

Part 3: Cost impact

Key cost measures

- The time taken to progress a case in the system from referral till MDT decision. These were costed, utilising standardised NHS costs for both administrative and clinical time.
- The total cost per case was then evaluated, comparing phase 1 (pre-project) against phase 2 (the implemented project, with eAIMS implementation and prioritisation process).

Evolution of our understanding of the financial impact

- A key deliverable was the identification of all AI cases. Even in our hands, with a dedicated well-publicised MDT, only 30% of AIs are referred.
- We have therefore, evolved our process to allow us to streamline the process even further to enable handling more cases in a cost-effective manner. Our projected (phase 3) figures are encouraging. These will be formally evaluated, using the specifically-designed A_2CAT.

Estimating costs of existing services

- We process-mapped each step within the pathway, estimating the average time required. The staff time was costed using standardised DoH pay scales as described in the Health Economics report (Appendix 1.4).

Calculation of the cost of the intervention

- The cost of developing the eAIMS system is described in detail in the finance report (in addition to interim reports provided to the Health Foundation).
- To facilitate the development of a web-based system within the tight time frame of the project, we had to appoint a dedicated IT programmer. This meant we had to change the original costing allocations. This was shared with, and approved by, the Health Foundation early on.

Implementation costs

- Phase 2 evolved seamlessly and no additional cost implications were required. This was facilitated by the fact that the Trust noted the additional workload created by the AI work and appointed an additional band 4 MDT co-ordinator.

Benefits realisation

- Rather than simply accepting the current efficiency saving in phase 2, we are

pushing the boundaries to proceed to phase 3, with proactive AI detection. Whilst this could potentially increase the number of cases (previously missed), the streamlined process will offset these.

Commissioning considerations

- Each AI referred is costed as a new case as per agreement with CCG. When patients come for investigations to the Medical Investigations Unit, there is a standard visit tariff as agreed with the CCG
- We are engaging the commissioners to agree the most suitable and cost-effective way to manage these cases. Our system and pathway promises to handle more cases within the existing budget limitations, given the streamlined and efficient approach.
- We are engaging other Trusts, starting with the Association of British Clinical Diabetologists, to facilitate wider uptake and spread. This could be the beginning of a national registry. This will, in the future, form the basis of evidence-based data generation to inform further guideline development and remove waste whilst enhancing safety.

Part 4: Learning from your project

Achievements

We successfully:

- Developed the electronic Adrenal Incidentaloma Management System (eAIMS): Within the time scale, the system specifications were identified, blueprint developed then evolved into a prototype which went into repeated stages of iterative upgrades and modifications to ensure functionality and compliance with Information Governance. The success was enabled by:
    - Supportive Management Consultant (Mike Firn): This is our second project with Mike who has the unparalleled skill of appreciating the complexity of the project as if it were his own and dissect this into tangible practical blocks of work. He has an exceptional ability to relate to local issues as if he works "within", enabling him to provide the necessary advice. Finally, he supports rather than supervises, encouraging dialogue
    - Honest and open IT manager (Elloise Maddock): Despite the challenge of merging two hospital IT systems into one and a major infrastructure upgrade at the Trust, the IT colleague fully engaged and explored the best way forward. Instead of piecemeal time, she advised a dedicated programmer, introducing us to a freelance programmer, providing us with dedicated protected time that made this happen.
    - Supportive programmer (Chris Hale): Very enthusiastic, listened to our needs, translating them into IT options and accepted repeated debates and improvements. He continues to support after concluding his work officially
    - R&D Director (Prof Tony Fryer): Who partnered with me, ensuring appropriate communication within the Trust and opening necessary doors!
    - Dedicated and diligent MDT co-ordinator (Helen Robertson): Embraced the eAIMS and entered patient details, enabling us to test and re-test and finally improve. Currently, we have more than 100 records on the system
    - Shared vision: Web-based from the outset to be scaled into a national solution. Dr Basil Issa has been our partner at UHSM, spreading and implementing the innovation.
- Patient engagement event (focus group): This was enabled by the project manager, Dr Simon Lea, who co-ordinated with the Keele-based RDS PPI representative. Also the patients and their partners who attended provided an excellent insight on the degree of anxiety involved. We shared the plan for the development of eAIMS and gauged their thoughts on the patient journey to ensure efficiency yet, minimise anxiety/stress.
- Evidence-based guideline: Rather than surveying the practice in the UK then developing a consensus guideline, we were pleased that the European Society of

Endocrinology has released new guidelines and therefore, this provided the required up-to-date evidence-based foundation to the system.

Challenges

- Did not develop consensus guideline as became redundant (vide supra)
- Limitation of having to manually enter results. Had to be accepted within the limited budget of this pilot work and also to enable the system to be web-based.
- The incorporation of an outcome letter within eAIMS: Whilst initially outside the scope of the original application, we recognised early on the importance of this on saving time and reducing errors. Ultimately this will positively impact on uptake by other centres. We, therefore, insisted on this from early on and managed to achieve this within budget.

Specific learning on introducing and sustaining innovations in the NHS

- The need for open and supportive relationship with colleagues as that will overcome obstacles ('where there's a will there's a way').

Advice

- Share your vision with colleagues and genuinely seek their views. This will ensure collective ownership and willingness to overcome obstacles
- Learn how to say thank you and congratulate colleagues even with small "wins".
- For IT projects, early engagement of, and buy-in from, senior IT staff is critical.

Part 5: Sustainability and spread

Sustainability

- The eAIMS system is already in place and has become the default at UHNM. Indeed, we are already progressing it further to enable “proactive” AI identification. We are aware that only 30% of cases get referred. In this phase, we will identify all cases (instead of passively receiving merely 30%), write to the GP to inform them (Appendix 1.6) and recommend further investigations (if they wish to proceed).

- From the outset, we were aware of the key stakeholders who would influence future embedding, including them as partners on the application. This included Trust Executives, GPs, radiologists, biochemists, endocrinologists and patients. We consolidated this by holding Steering Group meetings throughout, in addition to ongoing informal discussions. This became obvious in the latter Steering Group discussions where the issue of funding/commissioning was intensely debated, including the Trust Medical Director and CCG representative.

Spread

- The web-based system has already been adopted by University Hospital of South Manchester and is confirmed to be fully functional. This will support the scaling up to be adopted by other Trusts.

Risks and challenges

- Commissioner lack of engagement: We have already engaged a GP colleague from the outset. During our last Steering Group meeting, we discussed in detail the options to ensure successful embedding, acknowledging the pressures on the NHS. The final conclusion, unanimously agreed, was to inform the GP of the newly identified AI lesions (with a recommendation course of action based on our initial review) and leave it with them to decide if they wish the patient to be referred accordingly. If they do, then this is a clinical decision. We have simplified the referral process to minimise unnecessary work for the GP or the Endocrine team.

- Endocrinology engagement/capacity: Endocrinology colleagues could fear being swamped by many proactively-identified AIs. Our approach, with eAIMS has been confirmed to reduce the time spent per patient, with a resultant reduced cost accordingly. We will share this with a cohort of our colleagues in the Spring meeting of the Association of British Clinical Diabetologists (Belfast, May 2017). The ABCD has invited us to discuss this important area and present our Health Foundation-funded innovation.

Plans for spreading innovation

- How? We will offer the system to Trusts across the UK.

- Replicability. The whole MDT and eAIMS utilisation is fully replicable. We intentionally progressed this project with scaling-up in mind, and hence included the second site trial even in the pilot phase.

Additional resources: No further funding is required for UHNM and UHSM. However, for national scaling-up:

- Further development of the eAIMS system to ensure more user-friendly and less time-consuming (e.g. a paper form to be scanned to allow data entry).
- Data management infra-structure (eg system administrator) to manage the core system, ensure data quality, manage queries, facilitate audit, etc.
- Exploring other options to enhance and evaluate cost-effectiveness, patient benefit (as measured by changes in anxiety levels).

We are considering further Health Foundation funding for some of these elements.

<u>Upcoming milestones/ activities beyond HF funding</u>

- Immediately, we are progressing to proactive case detection as described above. Not only will this enhance patient safety, but it will also indirectly have educational benefits.
- Following this, we aim to scale up via engaging other centres, starting with the presentation at the ABCD meeting in May 2017.

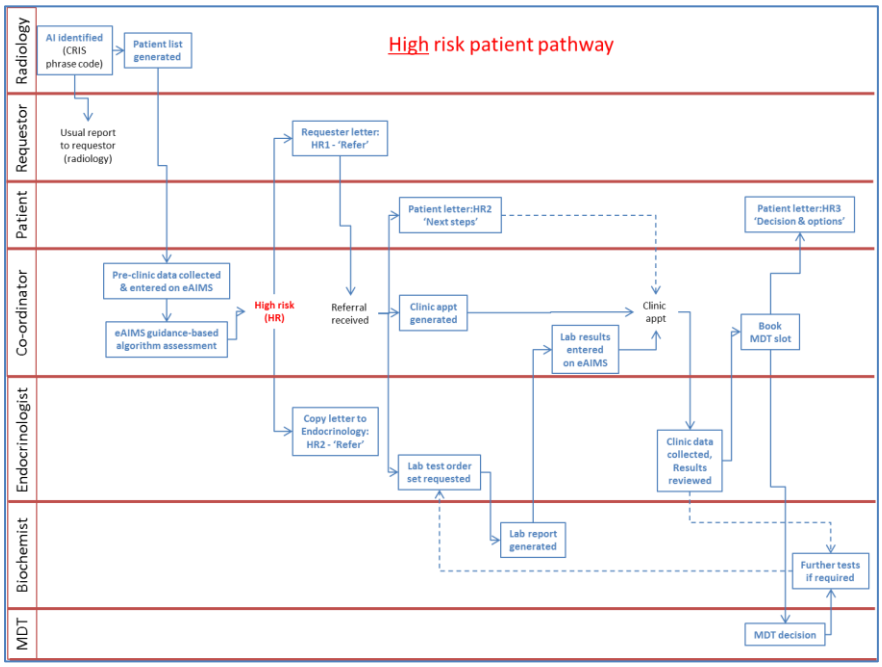
<u>External interest and recognition</u>

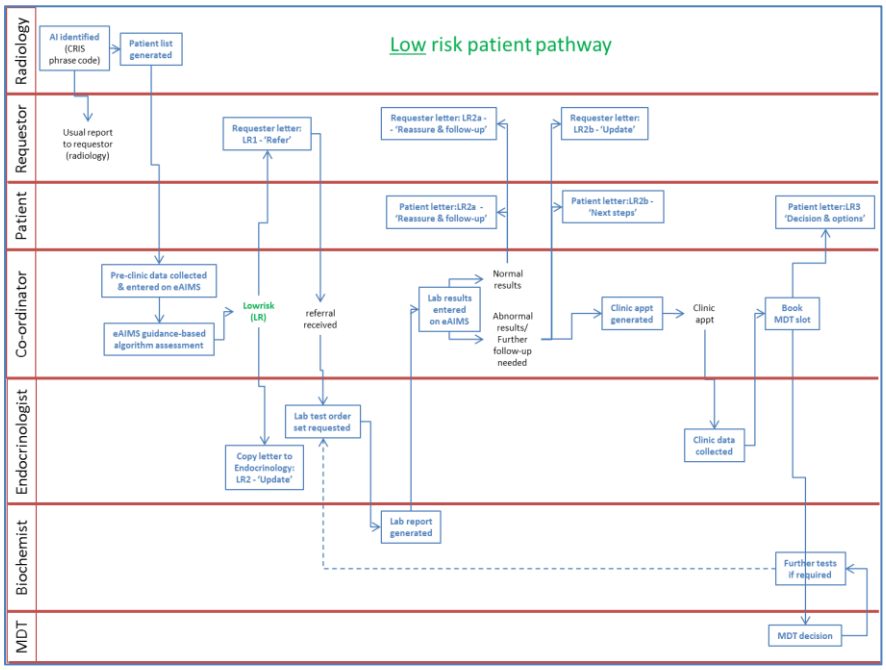
- Communities/networks targeted for spread included:
    - ABCD (As described above)
    - West Midlands Physicians' Association (poster accepted); May 2017
    - North Staffordshire and Stoke-on-Trent CCGs
- We also issued a press release upon receipt of the award and presented out baseline data at the Endocrine Society international conference in Boston in April 2016 (Appendix 1.7).

Appendix 1: Resources and appendices

Appendix 1.1

Process mapping: This represents the initial process map, for high- and low-risk AI cases, provided to IT early in the project to assist in the eAIMS system conceptualisation. The actual pathway evolved during the project based on Steering Group discussions. However, it was important to provide the IT team with the concept of what we were aiming to achieve.





Appendix 1.2

Sample MDT outcome letter:

This illustrates the letter that is auto-populated by the eAIMS system, thereby saving considerable time for both consultant and MDT co-ordinator.

MDT/Clinic Outcome Letter

Diabetes and Endocrinology
Royal Stoke University Hospital
Please insert contact details
Newcastle Road
Stoke-on-Trent
ST4 6QG

13 Feb 2017

Dear Dr Dr Smithi,

Re: Xxxxxx Yyyyyyyy 16/08/1947 118 sfkslfj lksjf lsjfad, Kidsgrove, Staffs, XSSSS
Diagnosis: Left 15mm adrenal incidentaloma

Comorbidities:

Results:

Urea and electrolytes

Date	Sodium	Potassium	Urea	Creatinine	eGFR
12/07/2016	138 mmol/L	4.5 mmol/L	5.1 mmol/L	77 µmol/L	89 mL/min/1.73m²
28/07/2016	140 mmol/L	3.9 mmol/L	5.2 mmol/L	79 µmol/L	90 mL/min/1.73m²

Overnight dexamethasone suppression test

Date	Serum cortisol
12/07/2016	78 nmol/L

Aldosterone/Renin Ratio

Date	Aldosterone	Renin	Aldosterone/Renin Ratio
12/07/2016	69 pmol/L	-	-

Low-dose dexamethasone suppression test

Date	Cortisol Baseline	Cortisol End	ACTH Baseline	ACTH End	24 hour urinary free cortisol levels - Day 1	24 hour urinary free cortisol levels - Day 2	24 hour urinary free cortisol levels - Day 3	24 hour urinary free cortisol levels - Day 4
27/07/2016	692 mmol/l	71 mmol/l	27.4 pg/l	<5 pg/l	-	-	-	-

Plasma metadrenalines

Date	Plasma Normetadrenaline	Plasma Metadrenaline
12/07/2016	0.99 nmol/L	-

Salivary Cortisol

Date	Day 1 Morning	Day 1 Evening	Day 2 Morning	Day 2 Evening	day 3 Morning	Day 3 Evening
31/08/2016	17.8 nmol/L	3.0 nmol/L	15.5 nmol/L	3.0 nmol/L	17.2 nmol/L	3.5 nmol/L

Reason for discussion Adrenal incidentaloma picked up on CT scan in March 2016 when being investigated for abdominal discomfort. MDT Outcome Repeat 2 day low dose Dexamethasone suppression test and salivary cortisol in 12 months. No further imaging required.

Appendix 1.3

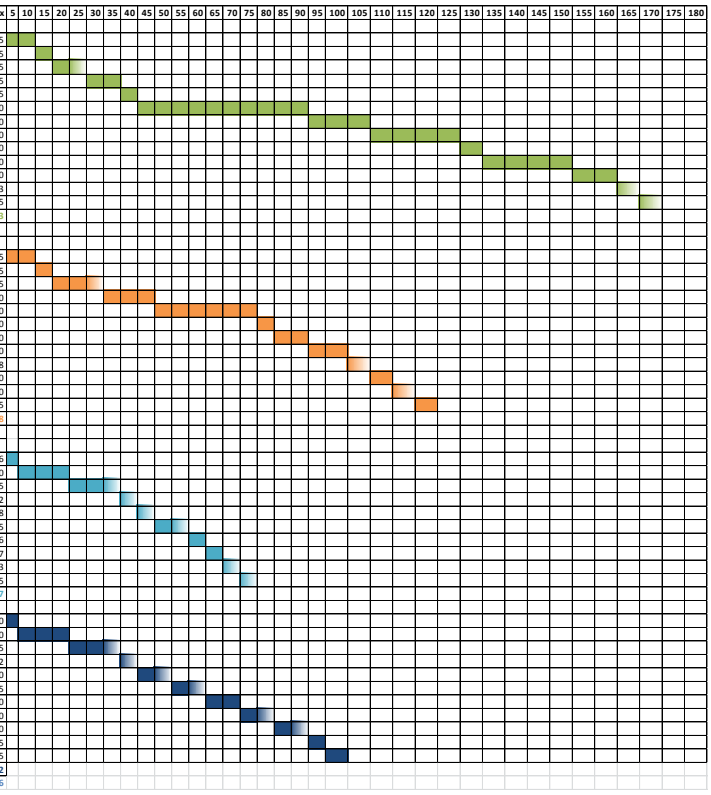
Time & Motion Gantt Chart

This shows the hands-on time for:

- the pre-project process
- following eAIMS and MDT prioritisation (Phase 1/2)
- following the proactive AI identification (Phase 3)

This chart graphically illustrates the time savings following each phase. NB: The data underpinning this were also used for the health economics analysis.

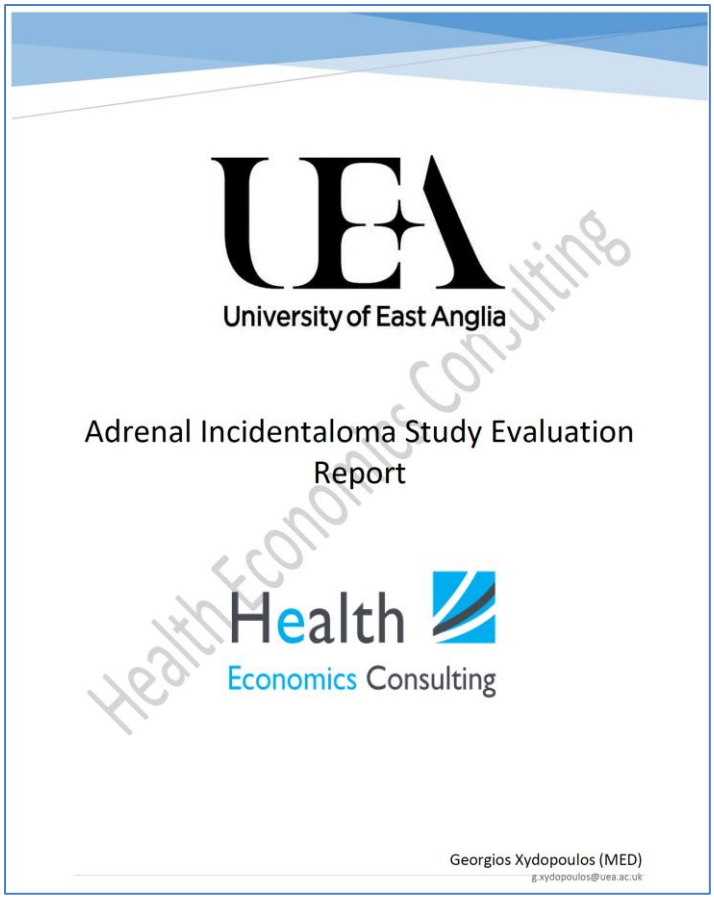
Step	who?	Time (mins)	min	max
Pre-project				
receive & prep referral	secretary	10	5	15
review referral letter & prelim decision	consultant	5	2	15
std letter customised/printed & tests requested	secretary	12	10	15
create MDT folder (printed letter + referral) pending results	secretary	10	5	15
checks twice weekly investigation dates to anticipate results	secretary	5	5	5
chasing lab tests results	secretary	50	20	90
review results+/-dictate letters +/-allocate MDT slot	consultant	15	10	30
re-review results & prepare MDT review	consultant	20	5	30
MDT discussion	MDT	5	3	10
MDT letter review & dictate	consultant	20	10	30
type MDT letter	secretary	10	5	20
sign MDT letter	consultant	2	1	3
post MDT letter	secretary	4	3	5
TOTAL		168	84	283
Phase 2 - eAIMS+prioritisation				
receive & prep referral	secretary	10	5	15
review referral letter & prelim decision	consultant	5	2	15
std letter customised/printed & tests requested	secretary	12	10	15
enter demographics & radiology data on eAIMS	secretary	15	10	20
chasing lab tests results	secretary	30	20	60
enter results on eAIMS	secretary	5	4	10
Provisional MDT letter printed	secretary	10	5	20
review results+/-dictate letters +/-allocate MDT slot	consultant	10	7	20
re-review results & prepare MDT review	consultant	4	3	8
MDT discussion	MDT	5	2	10
review provisional MDT letter as per MDT discussion	consultant	4	3	10
finalise MDT letter & transfer to Medisec	secretary	5	5	5
TOTAL		115	76	208
Phase 3 - eAIMS+proactive AI detection (low risk - 80% of pts)				
review all AI cases	consultantx2	5	4	6
enter demographics & radiology data on eAIMS	secretary	15	10	20
std letter customised/printed & tests requested	secretary	12	10	15
inform biochem of impending tests (email)	secretary	2	2	2
enter results on eAIMS & informs sec	Biochemist (~0.5xconsultant)	4	3	8
Provisional MDT letter printed	secretary	8	4	15
review results & finalise letter	consultant	5	4	6
type MDT letter	secretary	5	3	7
sign MDT letter	consultant	2	1	3
post MDT letter	secretary	4	3	5
TOTAL		62	44	87
Phase 3 - eAIMS+proactive AI detection (high risk - 20% of pts)				
review all AI cases	consultantx2	5	4	10
enter demographics + radiology data on eAIMS	secretary	15	10	20
std letter customised/printed & tests requested	secretary	12	10	15
inform biochem of impending tests (email)	secretary	2	2	2
enter results on eAIMS & informs sec	Biochemist (~0.5xconsultant)	6	5	10
Provisional MDT letter printed	secretary	8	4	15
review results+/-dictate letters +/-allocate MDT slot	consultant	10	7	20
re-review results & prepare MDT review	consultant	6	4	10
MDT discussion	MDT	7	5	10
review provisional MDT letter as per MDT discussion	consultant	5	3	15
finalise MDT letter & transfer to Medisec	secretary	5	5	5
TOTAL		81	59	132
TOTAL (low+high risk combined)		65.8	47	96

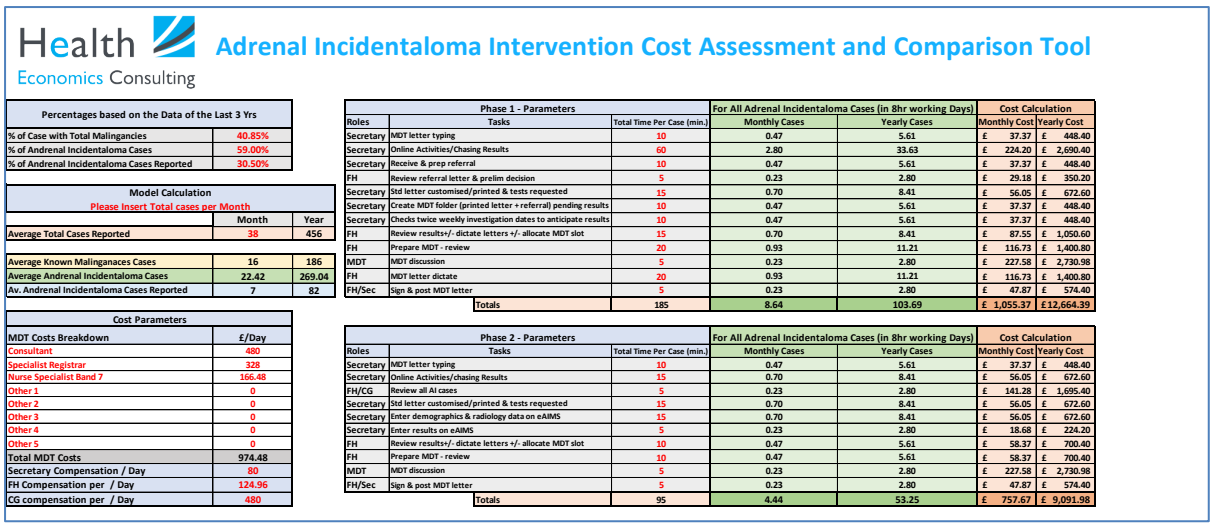


Appendix 1.4

Health Economics report and AI$_2$CAT

The health economics analysis was provided independently by Prof Ric Fordham's team (specifically by Georgios Xydopoulos) and is **attached separately**. They also developed the AI$_2$CAT spreadsheet, which will allow us to evaluate the impact of further developments (such as the current phase 3) as these are developed.





Health Economics Consulting

Adrenal Incidentaloma Intervention Cost Assessment and Comparison Tool

Percentages based on the Data of the Last 3 Yrs	
% of Case with Total Malingancies	40.85%
% of Andrenal Incidentaloma Cases	59.00%
% of Andrenal Incidentaloma Cases Reported	30.50%

Model Calculation Please Insert Total cases per Month		
	Month	Year
Average Total Cases Reported	38	456
Average Known Malinganaces Cases	16	186
Average Andrenal Incidentaloma Cases	22.42	269.04
Av. Andrenal Incidentaloma Cases Reported	7	82

Cost Parameters	
MDT Costs Breakdown	£/Day
Consultant	480
Specialist Registrar	328
Nurse Specialist Band 7	166.48
Other 1	0
Other 2	0
Other 3	0
Other 4	0
Other 5	0
Total MDT Costs	974.48
Secretary Compensation / Day	80
FH Compensation per / Day	124.96
CG compensation per / Day	480

Phase 1 - Parameters			For All Adrenal Incidentaloma Cases (in 8hr working Days)		Cost Calculation	
Roles	Tasks	Total Time Per Case (min.)	Monthly Cases	Yearly Cases	Monthly Cost	Yearly Cost
Secretary	MDT letter typing	10	0.47	5.61	£ 37.37	£ 448.40
Secretary	Online Activities/Chasing Results	60	2.80	33.63	£ 224.20	£ 2,690.40
Secretary	Receive & prep referral	10	0.47	5.61	£ 37.37	£ 448.40
FH	Review referral letter & prelim decision	5	0.23	2.80	£ 29.18	£ 350.20
Secretary	Std letter customised/printed & tests requested	15	0.70	8.41	£ 56.05	£ 672.60
Secretary	Create MDT folder (printed letter + referral) pending results	10	0.47	5.61	£ 37.37	£ 448.40
Secretary	Checks twice weekly investigation dates to anticipate results	10	0.47	5.61	£ 37.37	£ 448.40
FH	Review results+/- dictate letters +/- allocate MDT slot	15	0.70	8.41	£ 87.55	£ 1,050.60
FH	Prepare MDT - review	20	0.93	11.21	£ 116.73	£ 1,400.80
MDT	MDT discussion	5	0.23	2.80	£ 227.58	£ 2,730.98
FH	MDT letter dictate	20	0.93	11.21	£ 116.73	£ 1,400.80
FH/Sec	Sign & post MDT letter	5	0.23	2.80	£ 47.87	£ 574.40
	Totals	185	8.64	103.69	£ 1,055.37	£12,664.39

Phase 2 - Parameters			For All Adrenal Incidentaloma Cases (in 8hr working Days)		Cost Calculation	
Roles	Tasks	Total Time Per Case (min.)	Monthly Cases	Yearly Cases	Monthly Cost	Yearly Cost
Secretary	MDT letter typing	10	0.47	5.61	£ 37.37	£ 448.40
Secretary	Online Activities/chasing Results	15	0.70	8.41	£ 56.05	£ 672.60
FH/CG	Review all AI cases	5	0.23	2.80	£ 141.28	£ 1,695.40
Secretary	Std letter customised/printed & tests requested	15	0.70	8.41	£ 56.05	£ 672.60
Secretary	Enter demographics & radiology data on eAIMS	15	0.70	8.41	£ 56.05	£ 672.60
Secretary	Enter results on eAIMS	5	0.23	2.80	£ 18.68	£ 224.20
FH	Review results+/- dictate letters +/- allocate MDT slot	10	0.47	5.61	£ 58.37	£ 700.40
FH	Prepare MDT - review	10	0.47	5.61	£ 58.37	£ 700.40
MDT	MDT discussion	5	0.23	2.80	£ 227.58	£ 2,730.98
FH/Sec	Sign & post MDT letter	5	0.23	2.80	£ 47.87	£ 574.40
	Totals	95	4.44	53.25	£ 757.67	£ 9,091.98

Appendix 1.5

Patient Leaflet

The focus group discussions led to the development of the simple patient leaflet (in letter format) below, which will be further developed, along with a series of frequently asked questions (FAQs) for integration into a patient-facing section of eAIMS.

University Hospitals of North Midlands NHS
NHS Trust

FWFH/hr

1 March 2017

Royal Stoke University Hospital

Department of Diabetes & Endocrinology
Newcastle Road
Stoke-on-Trent
Staffordshire
ST4 6QG

Tel: 01782 679997/4
Fax: 0843 6365428

Dear

You have been referred by _____ to our team to look into more detail about the swellings that were found on the adrenal gland. The adrenal gland is a small but very important gland that sits on top of the Kidney. It secretes a group of hormones that are important for our well-being.

We are increasingly detecting these swellings incidentally because our scanners are becoming better. We know that these swellings would have likely been there for many years. They are also likely to stay largely unchanged with no harm to you.

However, we need to reassure ourselves and test them to ensure all is well. We will therefore arrange a few blood and urine tests. The results often take a few weeks to come back. When all the results are back, we will discuss them together the scans in our dedicated Adrenal meeting (where all the relevant consultants are present).

I will then write to you with the outcome and see you in the clinic to explain in person.

If you have any further questions please do not hesitate to call me on the above telephone number.

Yours sincerely

Prof F Hanna
Consultant/Hon Professor of Endocrinology and Metabolism

Appendix 1.6

GP letter for proactively identified AI cases

In phase 3 of the project (currently being developed post-project), we will identify proactively AI cases that are currently not being referred to the endocrinology team for appropriate follow-up. We have, following discussion with our GP collaborators, identified that the requestor of the original scan will need to be involved in the follow-up of these cases. We have therefore generated a simple template letter to inform them of the newly-identified AI to allow them to make an informed choice on subsequent management.

Your patient was identified to have an Adrenal Incidentaoloma

Patient details: Name, DOB, NHS No.

Size: ..... mm

Site: Rt Lt Bilateral (circle as appropriate)

Character: Adenoma (Y/N)

Indeterminate (Y/N)

Recommend: 1) Endocrine function tests (all cases)

2) Repeat scan (if indeterminate): Y/N

Do you wish to refer for the above investigations? (If yes, please fax to ---------

With this information please)

Does the patient have:

1. Hypertension? Y/N
2. Diabetes? Y/N

Medication list:

Appendix 1.7

Poster presentation at the Endocrine Society conference in Boston in April 2016.

This described the baseline data on time from AI identification to MDT decision, number of visits for investigations and number of letters generated, thereby illustrating the scale/magnitude of the problem.

University Hospitals of North Midlands NHS Trust

The Health Foundation

Keele University

INSTITUTE FOR SCIENCE AND TECHNOLOGY IN MEDICINE

Adrenal Incidentalomas: Unrecognised and Increasing Workload

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(1)Department of Diabetes and Endocrinology, (4) Radiology, (5) Urology, (6) Research and Development, and (7) Clinical Biochemistry,
University Hospitals of North Midlands, Stoke on Trent, United Kingdom,
(2) Department of Endocrinology and Diabetes, University Hospital of South Manchester, Manchester, United Kingdom,
(8) Institute for Science & Technology in Medicine, University of Keele, United Kingdom

Background
Adrenal incidentalomas (AIs) are unexpected (incidental) lesions identified as part of diagnostic imaging tests for various indications. They represent a challenge to healthcare systems globally, for two reasons. Firstly, numbers of AI are rising rapidly as a result of increased CT and MRI scan utilisation in diagnostic pathways and the ageing population (prevalence: 6.9% above 70 years vs 0.2% below 30 years; **Young WE Jr., 2000**). Secondly, AIs represent a major clinical risk, with almost 20% either functional or malignant (**Young WE Jr., 2000**).

Setting:
In our centre, we developed a dedicated multidisciplinary team to manage AI, including a monthly multidisciplinary team (MDT) meeting
MDT includes: Endocrinologists, radiologists, surgeons and clinical biochemists.
Cases are discussed in the meeting after the hormonal profile and imaging have been concluded.
The decision is shared with the patients and their primary care clinicians.

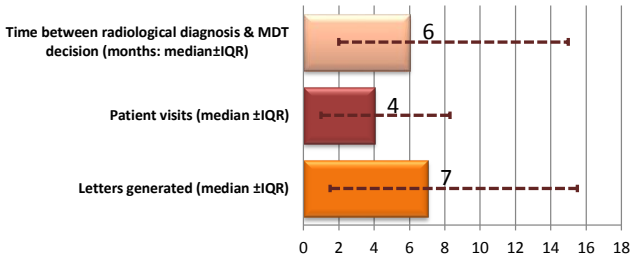
Aim:
To quantify the impact of managing AIs on both the patient and the healthcare system, as judged by the available data generated from the MDT, including:
(1) Time delay from identifying AI to definitive decision at MDT

(2) the number of visits by the patient for investigation and or clinic appointments

(3) The number of letters created in relation to the management of the AI (including correspondence with the patient as well as informing the primary care physician of the outcome of results, clinic attendance or MDT outcome)

Results

(Despite a dedicated MDT and supporting investigation unit)



Variable pattern of testing depending on the clinician requesting the initial scan.

Discussion/Conclusion:
- AI management is an arduous task: organising investigations, chasing and interpreting results (often received piecemeal), then planning further testing and/or clinic visits. In addition, the patient needs to be kept informed during this time, given the unavoidable anxiety.
- Despite our dedicated MDT, the timeliness of diagnosis remains suboptimal, (> 50% of patients without decision after 6 months)
- In most centres, there is no dedicated MDT AI infrastructure are likely to have an even longer time lag,
- Our infrastructure enabled for the first time, in a clinical setting, the documentation of the significant workload generated during the management of AI.
- Furthermore, the negative impact of such delay on the patients should not be underestimated and more work is required to streamline the management of AI and develop evidence-based guidelines, with health-economics evaluation