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Shine

Shine 2012 final report

Operational research modelling: transferring ENT/audiology services into a community setting

Cardiff and Vale University Health Board
School of Mathematics, Cardiff University

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Part 1. Abstract

Project title: Operational research modelling: transferring ENT/audiology services into a community setting

Lead organisation: Cardiff and Vale University Health Board

Partner organisation: Cardiff University (School of Mathematics)

Lead Clinician: Mr Alun Tomkinson

Abstract

The project is being run by the Cardiff and Vale University Health Board (UHB), with clinical leadership provided by a consultant otolaryngologist. It is supported by academics from the Operational Research group at Cardiff University's School of Mathematics, which has a strong background in helping transform NHS care delivery through mathematical modelling. Further support is provided by experts in innovation and improvement at the Health Board, clinicians, the directorate manager and finance staff.

The project focuses on service redesign, primarily relocation of services, of Ear, Nose and Throat (ENT) and Audiology outpatient provision. Services are often situated in highly centralised and hard-to-access locations, with access being additionally difficult for the ageing population. The annual cost of missed appointments in Wales alone through poor communication with people with hearing loss is circa £1m.

Appointments have traditionally been offered at the University Hospital of Wales (UHW), a large teaching hospital in Cardiff. The clinic is often overcrowded and waiting times can be long. Parking on site causes significant problems. There are numerous car parks located within the UHW site, but frequently are overcrowded with long queues. Patients must also pay to use the car parks owing to a Private Finance Initiative.

A primary deliverable of this project is the creation of a generic, user-friendly model which will assist with decisions regarding service redesign and resource/location allocation. This model will allow healthcare managers to more accurately plan future service specifications and ensure better informed decision making and, while it was developed with input from ENT and Audiology staff, it is designed to be suitable for any specialty. The model, built in Microsoft Excel to facilitate universal use, was presented to the project Steering Group (SG) for critical advice and feedback very early in the development phase.

Aims

Our key aims are summarised below:

- Develop new ways of planning service redesign via a robust model which captures value.
- Reduced the demand on secondary care facilities, with improved waiting times, fewer no-shows and a reduction in carbon footprint.
- Demonstrate an improvement in quality of care, including patient experience.
- Contribute to the wider evidence base on the benefits of moving secondary care services into the primary care setting.

Value is at the centre of what we are aiming to capture. This comprises of three key elements; cost, quality and patient experience. Briefly, cost includes traditional elements such as clinic costs, but also incorporates travel costs (incurred by the patient and the UHB) and socio-economic costs (time off work, for example). Efficiency, using Did Not Attend (DNA) rates as an indicator measure, time, carbon footprint and safety are measures of quality. Patient experience includes more qualitative measures and was captured via patient stories, a patient focus group and patient questionnaires.

A number of key variables were identified for inclusion in the decision tool and agreed by the SG. Some are not available using standard data sources and therefore any gaps were filled via patient questionnaires. These were created and implemented using a Plan-Do-Study-Act (PDSA) approach, crucially enabling quick and effective changes to be made in a timely manner.

Three questionnaires were developed in total; an extract of one is presented in Appendix 2. In addition to the questionnaire, patients were also given an information sheet detailing the purpose of the questionnaire, alongside assurances over data protection and quality of care. The forms were designed so that the questionnaire, as far as possible, was machine readable, the aim being to reduce input time and eliminate human input error. An ‘any other comments’ section was also included to capture unbiased qualitative data.

Overall, four different tools have been developed:

- Decision making tool which optimises the value of service redesign
- A geographic information system (GIS) mapping tool
- Travel time/distance look-up tool
- Value calculator

Each of these tools comes with a comprehensive, easy-to-follow user guide.

Only the first listed item was planned for as part of this project; the other three have come as unintended consequences. A significant achievement was made when funding was secured for a CUROP (Cardiff University Research Opportunities Programme) project. This enables the employment of an undergraduate student, at no additional expense to our project, who spent eight weeks developing and testing the (GIS) tool. This was designed to act as a standalone programme that, in summary, visually maps demand and supply locations and

calculates distance and time matrices between these points. It can also be used to calculate inputs to the decision making tool.

Results

We have demonstrated that significant quality gains can be made in patient experience and acceptability of moving secondary care services to more accessible primary and community settings via a thorough evaluation of a pilot clinic.

Savings accrue directly to patients via travel costs and time savings, while productivity gains are realised within secondary care from reduced do not attend (DNA) rates and fewer rescheduled appointments. Savings in travel distance also reduced the carbon footprint.

Results from pilot

Measure	Change
DNA rates	↓ 13% to < 1%
Appointment costs*	↓ 70%
Patient travel time	↓ 62%
Patient travel distance	↓ 67%
Patient travel costs	↓ 60%, £4.80 saving per appointment
Travel carbon emissions	↓ 51%

* Cost to UHB of provided outpatient appointments reduced by 70% by transferring services to pilot site

The average score from patients when asked to rate the move was 9.0/10, with 70% rating the move 10/10.

Comparative costs are shown in Sections 2 and 3.

Key learning points

Collaboration

- Collaboration between the UHB and CU has proved to be successful. The organisations each bring their own expertise and viewpoint, which placed us in good stead for developing a model that is applicable, useable and accurate.
- Inclusion and involvement of key stakeholders from the beginning of the project has ensured, most critically, that *relevant* progress was made.

Data

- Data acquisition was an issue at various points throughout the project and was resolved each time when escalted to the Steering Group.

Unintended Consequences

- Other challenges came as unexpected, but positive, by-products. For example, completion of the **PatMap tool** led to interest from other parties which, while welcomed, took up a considerable amount of time.
- The useful insights gained from **patient stories** also meant a rollout to additional patient cohorts and the co-ordination of a patient focus group. These were found to be very valuable exercises but the time investment has been significantly greater than originally planned.

Part 2. Quality impact: outcomes

A self-contained community facility, situated within a local GP practice (West Quay Medical Centre; WQMC), has enabled 5,000-7,000 people to receive care outside of the hospital based outpatient setting. This primary care practice is based in Barry, South Wales, 12 miles from the secondary care setting (University Hospital of Wales, Cardiff; UHW). As a result of the service transfer, patients have less distance to travel and a stark decrease in DNA rates has been observed, running at less than 1% at WQMC, compared to 13% in 2012/13 at UHW.

Further data collection and analysis has enabled the quantification of distance, time, carbon footprint and cost savings. Mode of transport was collected via patient surveys so that more accurate estimations could be made. The average distance saving is 13 miles (return journey), a 67% reduction on the distance travelled to the secondary care facility. The average travel time saving is 31 minutes per appointment, a 62% reduction. This translates to a 60% cost saving for patient travel, with an average saving of £4.80 per appointment. Carbon emissions were reduced by 51% per appointment (patient travel), a saving of almost 3kg CO_2e.

The cost to the UHB has also been significantly reduced, with a 70% reduction in appointment costs for this patient cohort. The reduced DNA rate means that there is less wasted cost (due to fixed overheads and staff 'idle' time for example); at UHW, 11% of the total appointment costs were wasted, compared to almost nil at WQMC.

Acquisition of data was one of the main challenges we have faced. It was collected from a variety of sources and needed to be validated prior to analysis. Data not routinely collected was gathered via patient surveys (see Appendix 2A). Dissemination, collection and analysis of these questionnaires proved to be problematic. While the surveys were designed so that the majority of answers could be read electronically, many questionnaires were not filled out according to the instructions, see Appendix 2B.

16 patients were interviewed as part of the patient stories programme. As a result of this, three separate reports (ENT nurse practitioners, Audiology and WQMC) were published, which included detailed results and recommendations for improvement measures. . Comprehensive action points were provided and the key stakeholder for each was identified. See Appendix 2C for more information. Patient experience of using WQMC further supports the quantitative benefits previously described.

Sample of patient quotes relating to WQMC

"West Quay is less crowded, less busy, less intrusive. And there are windows!"

"The parking is excellent, I had trouble at the main clinic."

"It's a much nicer place at Barry, a nice environment to wait in, more modern."

"I can't fault the service. Fantastic."

"It's luxury, you don't have to pay for parking. Ace."

"I can't think of any downsides to the move."

A patient focus group for the new patients head and neck cancer clinic was also hosted. This was an ad-hoc decision made on the basis of the success of the patient stories. This provision was originally not included as part of the service which we intended to analyse, but nonetheless the results were well received by the team. More information on this is provided in Appendix 2D.

Assurances of quality relating to the suite of four developed tools can be made regarding their fitness for purpose and accuracy. The relevance comes from this project being a collaboration between various stakeholders, each with their own expertise and interest, in order to ensure the tools developed can be used for real-life healthcare applications. Their accuracy comes from thorough testing and careful walk-throughs of the modelling process.

Part 3. Cost impact

The premise for the development of the model was to inform business decision analysis, with a particular emphasis on determining value. In this case, we identified four key quantifiable elements that together represent value; cost to the NHS, cost to patients, travel distances and carbon footprint. The 'cost' therefore, that we are quantifying, is more than the monetary cost of providing a service, though monetary costs are an important tangible component. Since value is a dimensionless measure, we score it on a scale of 0 to 100 using a Relative Value Score (ReVS). Each of the four variables can additionally be weighted so that the user can rate them according to importance for their own particular setting. Quality of a service and the patient experience are also evaluated, via both quantitative and qualitative means. More detail is provided on each of the four developed tools in Appendix 2E.

Typical NHS approaches to cost-benefit analysis fail to capture the necessary details and variability of healthcare processes leading to misleading and incorrect conclusions. Operational Research (OR) offers a toolkit of methods to model the complexities of the service and provide the necessary qualitative and quantitative insights to decision makers. This project uniquely brings together experts in service delivery (ENT), modelling (Operational Research) and service improvement to develop and determine value (cost, quality, patient experience) in a transparent and reliable manner.

Detailed costs have been included as part of the decision-making tool in order to gain highly accurate results. Detailed UHB costs include splitting appointment costs by whether or not a patient attends the fixed costs of setting up new facilities and the costs incurred of transporting patients to and from outpatient appointments using ambulance services. The costs incurred by patients are multi-faceted and can be measured not only financially, but also in terms of time and carbon footprint. Transport costs are calculated dependent upon location and mode of travel, and include car park fees where appropriate. It should be observed that the Welsh Government have a 'no parking charge' for attendance at NHS hospitals. However, owing to a Private Financial Initiative, car parking costs for patients and staff remain at UHW with a cost of £2.20 for a 4-hour period.

Estimated outpatient appointment costs at UHW are £94.40 per appointment, reduced to £27.73 at West Quay. These figures are calculated via consideration of both fixed (staff, overheads, etc.) and variable (consumables) costs at each facility. The West Quay cost is calculated from a fixed cost for the service provision divided by the number of patients seen. Service costs to the UHB, defined as the cost of providing the appointment, have been reduced by 70% for ENT appointments transferred to the pilot site. There has also been a reduction in 'wasted' costs; those costs incurred by patients who DNA. At the pilot site, wasted costs are almost nil, whereas previously 11% of all costs could be deemed wasteful based on the DNA rate for clinic appointments.

Tool development costs are absorbed by the original Shine funding. Further implementation savings, beyond the changes already made, are predicted by the decision-making tool.

Part 4: Learning from your project

Summary of Key Learning

	Level		
	Macro	**Meso**	**Micro**
What went well	• Collaborative approach between the Health Foundation, the healthcare organisation and the academic department.	• Leadership and support provided from clinical, managerial and academic experts aided project development. • Opportunity to showcase the developments at the Faculty for Quality Improvement, and at the ISQua conference • CUROP project.	• Acquisition of honorary UHB contract for Project Manager. • Accessibility of key colleagues to support project milestones. • Opportunity to undertake Patient Story training.
What were the challenges (and approaches for tackling these – see below)	• Understanding the culture of the NHS.	• Loss of champion of surveys partway through project. • Additional time required for CUROP project.	• Accessibility of data. • Software development. • Patient surveys data input.

The collaborative approach between Cardiff and Vale UHB and Cardiff University proved to be very successful. The relationship forged between the two organisations enabled input from a variety of viewpoints and has created an innovative approach to tackling problems in healthcare. The valuable support and leadership provided by the various stakeholders has been instrumental in making this project a success. Crucially, staff buy-in at a high level was achieved early since colleagues from various departments were involved in the original bid. Extra effort was required with additional staff members but their accessibility and willingness to help meant that this was not a problem. The only improvement that could have been made here would have been identifying key sources of help from the outset and explicitly defining responsibilities for individual work areas.

A Steering Group was established and was useful in defining the key stakeholders. While the Group did not meet perhaps as often as would have been ideal, the accessibility of all members is acknowledged as a vitally important benefit. Further the project manager and Innovation & Improvement lead met at regular intervals and this ensured that key milestones were met and project constraints were proactively managed.

This culture of innovation is evidenced by the successful bid for a summer placement student. The output of that sub-project was a patient mapping tool and momentum was soon gained in marketing the tool within, and beyond, the UHB. While this was an excellent and unintended consequence, it did lead to a change in resource allocation within the project. While interest in the tool is extremely welcomed, a considerable amount of extra time was required to develop the tool and its accompanying materials, meet with additional interested parties and deal with user queries. The application by the same core group of colleagues for a Shine 2014 award is further testament to the success of our collaboration.

The Project Manager was given an honorary contract by the UHB for the duration of the project. This made many day-to-day tasks simpler, or even possible in some cases. For example, the patient stories and focus group have been a vital part of this project, and would have not been possible had the contract not been in place. It also meant that a more autonomous, impartial approach was taken towards these exercises. However, this was not without its problems; understanding the culture of the NHS was a learning curve for the Project Manager. However, due to the close working relationship with the UHB, this did not hinder the project. Access to data was also permitted because of the honorary contract. Despite this, data access was an issue throughout the project, particularly understanding what data was readily available and how to access it.

Patient surveys were used to address data gaps. A doctor from the ENT clinic was recruited to assist with this, to act as the on the ground contact for dissemination and collection of the surveys. Having somebody within the clinic who was responsible for this, and who could act a champion amongst their clinical colleagues, proved to be very beneficial. However, this was lost partway through the project due to a change in staffing roles and co-ordinating the surveys remotely proved to be more difficult. In hindsight, it would have been beneficial to recruit another staff member from the clinic to act as the surveys champion.

Another unexpected issue arose with the patient surveys – data input. The paper-based surveys were designed and implemented using a PDSA approach in an attempt to optimise their fitness for purpose and ease of completion. They were designed so that, for the most part, responses could be read automatically via a computer. This approach relies on the surveys being completed appropriately and unfortunately it was found in many cases that this did not happen, see Appendix 2B. If we were to do this project again, we would propose a manual approach to data entry be incorporated into the project design.

Software development was, albeit accidentally, approached using PDSA methodology. Time was spent developing a model using one piece of software, and then an attempt was made to transfer this to a different programming language. Unfortunately, this transition was not simple and it was ultimately decided to revert back to the original approach.

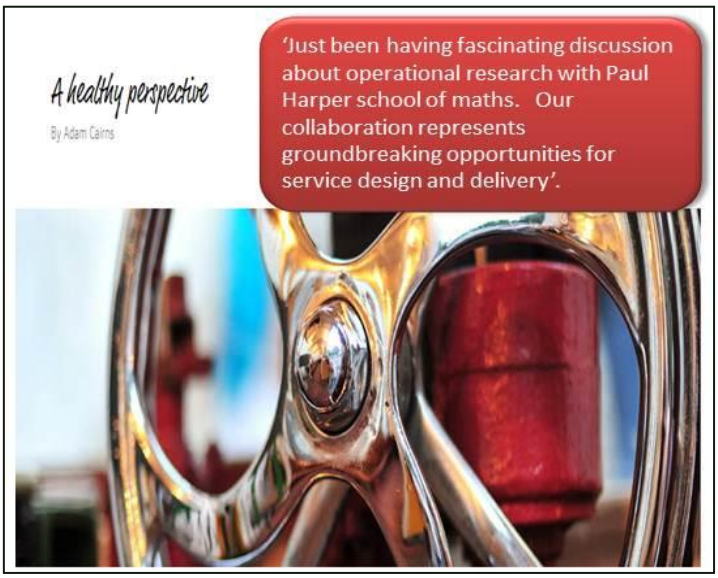
Part 5. Plans for sustainability and spread

A number of tools have been developed as part of this project. Since these have been purposefully designed to be robust, generic and transferable, we are confident that dissemination of them beyond this project will be successful. User guides have been written to accompany the tools to assist easy dissemination. Three of the tools were built in Microsoft Excel to facilitate universal use. The other tool was built to be executable on any standard Windows 7 machine. This approach means that it is highly likely that other users will have the necessary software to run our programs. Dissemination of the tools is likely to be via email or transferable media (e.g. USB sticks) in the first instance, with the hope of hoping them on the internet in future.

This work has been presented at both national and international conferences. See Appendix 2G.

The CEO of Cardiff and Vale UHB, Adam Cairns, has also publicised our work both on Twitter (> 1,300 followers) and his blog (> 1,400 followers). Initially this was prior to the beginning of our project and recognises the innovative approach to collaboration.

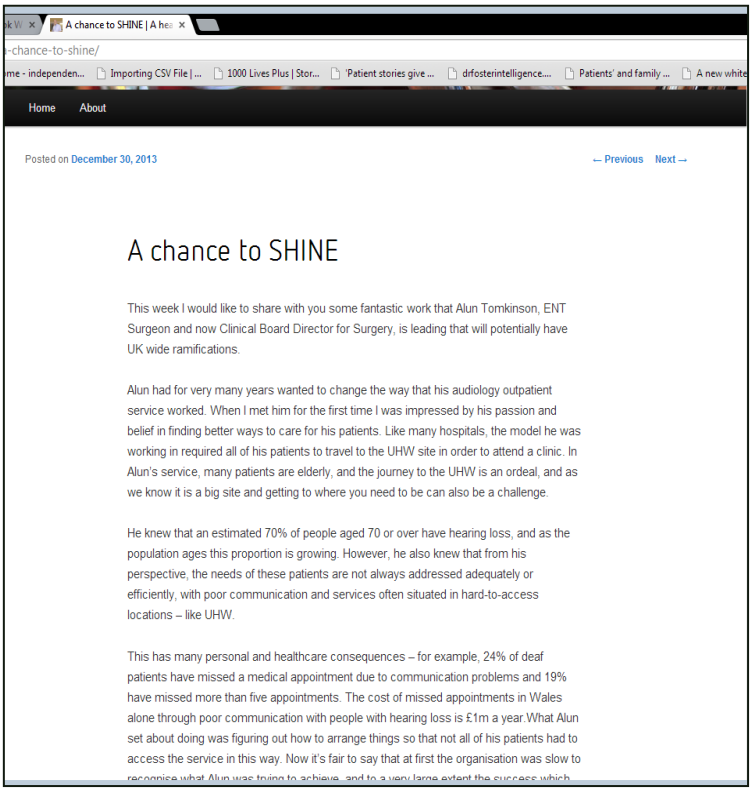
UHB CEO blog post 1



A lengthier article on the project, entitled 'A chance to SHINE', was published in December 2013 and also linked via Twitter.

The full post can be seen at http://adamcairns.net/2013/12/30/a-chance-to-shine/.

UHB CEO blog post 2



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Posted on December 30, 2013

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A chance to SHINE

This week I would like to share with you some fantastic work that Alun Tomkinson, ENT Surgeon and now Clinical Board Director for Surgery, is leading that will potentially have UK wide ramifications.

Alun had for very many years wanted to change the way that his audiology outpatient service worked. When I met him for the first time I was impressed by his passion and belief in finding better ways to care for his patients. Like many hospitals, the model he was working in required all of his patients to travel to the UHW site in order to attend a clinic. In Alun's service, many patients are elderly, and the journey to the UHW is an ordeal, and as we know it is a big site and getting to where you need to be can also be a challenge.

He knew that an estimated 70% of people aged 70 or over have hearing loss, and as the population ages this proportion is growing. However, he also knew that from his perspective, the needs of these patients are not always addressed adequately or efficiently, with poor communication and services often situated in hard-to-access locations – like UHW.

This has many personal and healthcare consequences – for example, 24% of deaf patients have missed a medical appointment due to communication problems and 19% have missed more than five appointments. The cost of missed appointments in Wales alone through poor communication with people with hearing loss is £1m a year.What Alun set about doing was figuring out how to arrange things so that not all of his patients had to access the service in this way. Now it's fair to say that at first the organisation was slow to recognise what Alun was trying to achieve, and to a very large extent the success which

Patients will be informed of changes made as a result of this project via leaflets and posters in clinic. See Appendix 2G for an example.

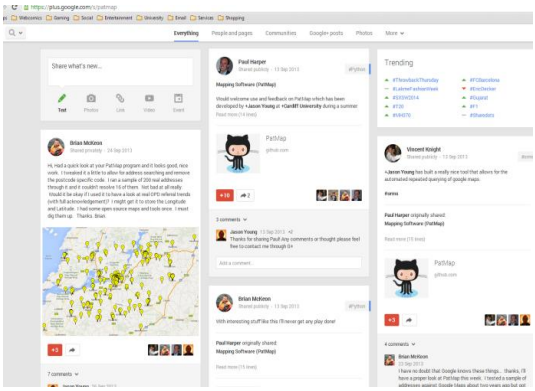
Publication in high quality journals will also be pursued post-March 2014. Media departments at the UHB and/or CU will be contacted if appropriate in order to demonstrate results to a wider and more public audience. The collaborative is also considering entering the Health Service Journal Awards 2014.

We have already identified a number of other interested parties. Meetings have taken place with colleagues from within the UHB, specifically from Immunology and the Patient Administration and Outpatients Directorate. Analysis of data from a neighbouring Health Board (Aneurin Bevan) has also aided them with planning of paediatric tonsillectomy services. Additional demonstrations are arranged with other directorates within the UHB.

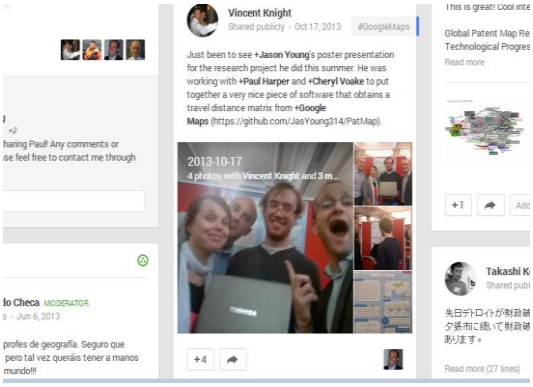
A team from a previous Shine award, namely Shanti Vijayaraghavan and Desirée Campbell-Richards from Barts Health NHS Trust in East London, have also shown a keen interest in our mapping tool. An initial meeting has taken place with a further session planned to include a larger group from the Trust.

Members of the team involved in this project are well-connected across the academic and healthcare community and regularly post updates to social media networks such as G+; our academic team have in total over 40,000 individual followers on G+. We also found this to be a useful way to reach out to coding experts.

G+ posts



Receiving feedback from coding experts



Members of the team at the CUROP poster conference

Opportunities to showcase our work at internal and external meetings will be pursued. Advice or funding available in order to do this is welcomed. We believe that this innovative work will be of interest to a wide range of healthcare professionals, aided particularly by the generalisable nature of the developed tools, and will seek to demonstrate them wherever possible.

Appendix 2: Resources from the project

A – Patient survey extract:

UHW

1 Adult

2 *Office use only:* Time in ..... Time out ..... Next follow-up (months) .....

□ Audiology □ Ear clean □ Other .....

3 **Instructions:**

Use blue or black pen to mark your answers by filling in the circles: ① ● ③

1. What year were you born? [ ][ ][ ][ ] 4 e.g. [1][9][6][6]

2. Are you...? 5 ① Male ② Female ③ Prefer not to say

3. What is your home postcode 6 (excluding the last two letters)?

[ ][ ][ ][ ] [ ][-][-] e.g. [C][F][1][4] [4][-][-]

1 Three separate questionnaires are used, so each questionnaire is clearly labelled in top left-hand corner for clear distinction and to avoid any confusion for staff.

2 Patient completes questionnaire while waiting and takes into their appointment, where clinician completes this section and keeps the form. This helps to maximise response rate.

3 Clear instructions are provided and sans serif size 14 font used throughout to make the form as easy as possible to read and understand. (Many of the patients are elderly.) Pens are provided to help maximise response rate.

4 Clear answer boxes and examples are used to enhance user-friendliness.

5 The survey was designed so that questions of this type were machine-readable so no user input is required. However, several issues were faced (see next section).

6 Steps taken to ensure no individual patient can be identified by excluding some information; for example, year of birth instead of full date of birth and sector postcode instead of unit postcode.

B – Issues faced with patient surveys:

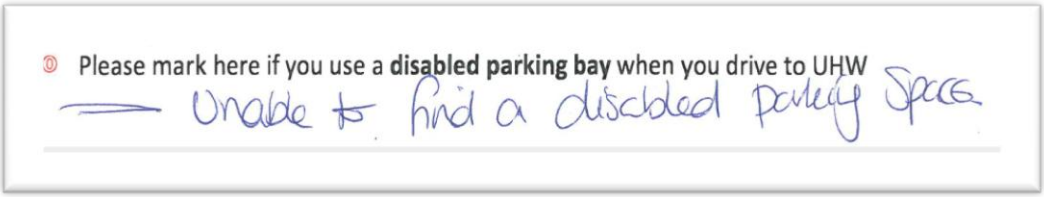
The surveys were designed so that the majority of answers could be read electronically, thus reducing human input. However, many questionnaires were not filled out according to the instructions.

Our machine-readable questionnaires required the circle to be filled in to indicate the chosen response. A selection of collected responses which are not suitable to be read by the machine is given below. Many patients ticked or circled their chosen answer. While it is clear which answer they have indicated to the naked eye, many are not recognised by the machine. In other cases, patients marked the desired option itself, and not the circle next to the answer.

The manual intervention required to resolve these problems outweighed the benefits that would be gained from feeding the completed surveys through the automatic reader, and thus ultimately all surveys were inputted manually resulting in it being a highly time-consuming exercise. Another common oversight was to indicate near the word or sentence using, usually, a tick or a cross. As previously, it is always identifiable what the chosen option is, but this would not be read by the scanner.

Three questions asked for times from the patients relating to their journey to clinic. While these answers could not be read automatically by the scanner and still required human input, some answers still caused confusion. For example, an observed entry of 20:00 is infeasible. While some answers could be guessed (2pm for example), it is simply not possible to infer the correct answer. This was recorded as a missing value.

Comments were invited at the end of the questionnaire. The section for comments could be scanned as a separate image, making collating of them easier. However, in several cases comments would be left elsewhere on the form and thus would be missed if the scanner was used. These additional comments are very useful in evaluating the service and therefore should not be overlooked.



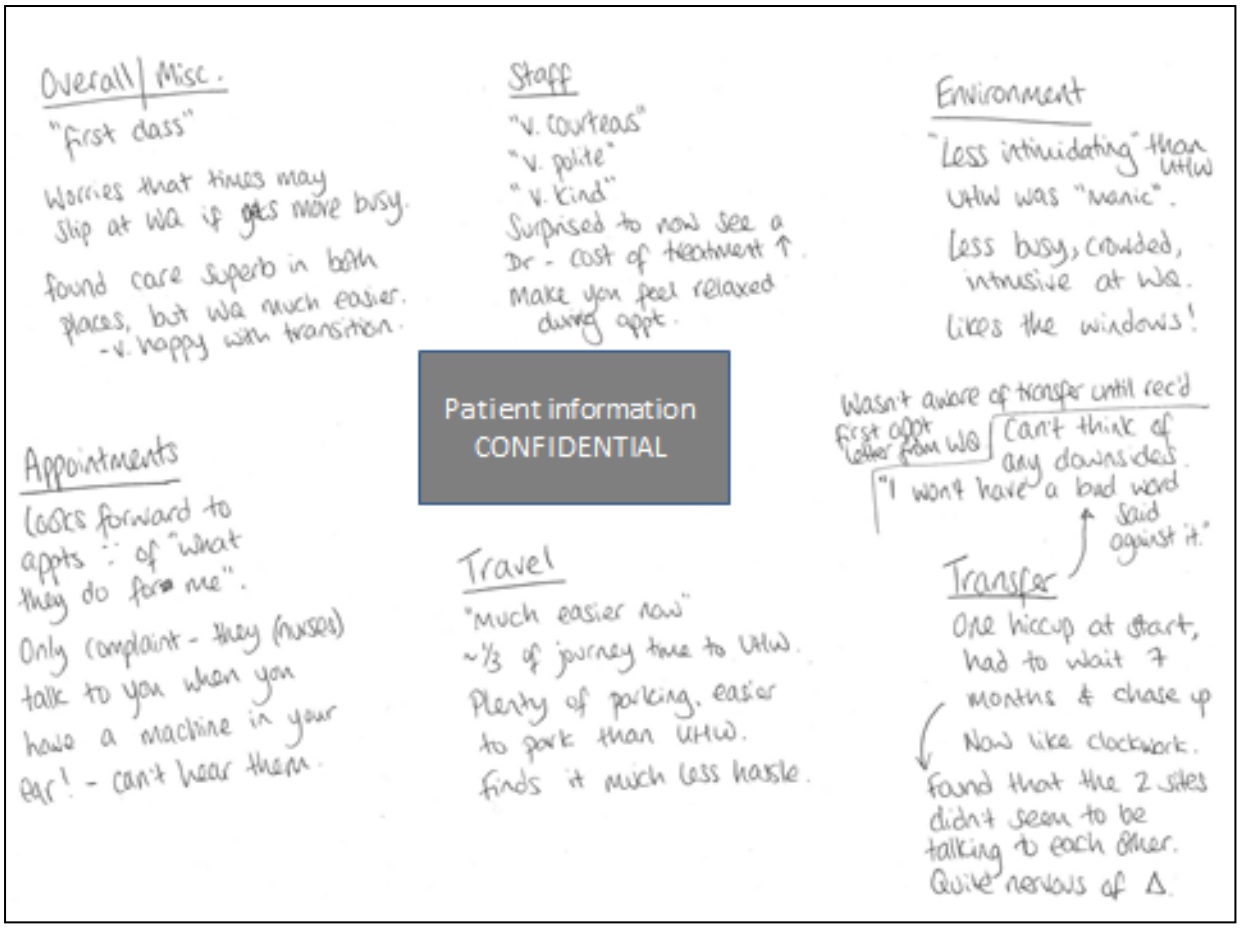
C – Patient stories analysis:

Each patient interview was tape recorded and listened to promptly, always within 72 hours of the interview taking place. The contents were then analysed using cognitive mapping. One map was completed per interview, starting with the patient's information in the centre and working outwards; significant comments, statements, descriptions and events were all noted down for each patient. These were split into themes where relevant. Once the patient map was complete, the interview was listened to once more to ensure that nothing had been omitted.

The complete set of maps was then scrutinised and themes were identified for each patient group. For the final reports (provided to managers and clinicians), results were split into the themes that were most commonly identified during the analysis.

Three reports were produced in total; one for WQMC, one for the ENT nurse practitioners clinic at UHW and one for Audiology (cross-site).

Patient map example



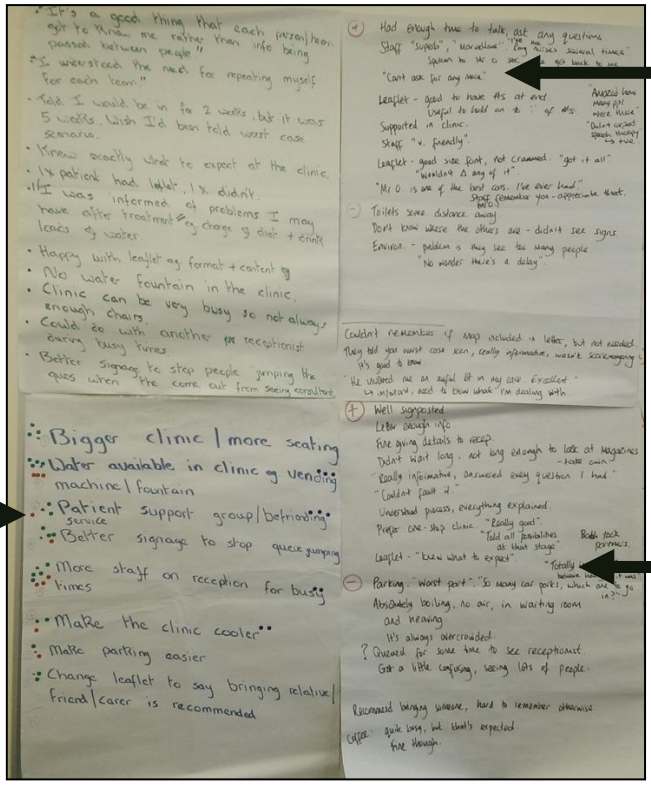
D – Patient focus group:

The success of the patient stories exercise led to us holding a patient focus group for head and neck cancer patients. The option of a one-to-one interview was also given and was used to gain feedback from some patients. For the focus group, patients were split into two groups, each with two staff members; one to act as a facilitator, asking questions and inviting discussion, while the other acted as a scribe, noting down patient comments and quotations.

Patients were invited to give feedback on any aspect of the clinic and were encouraged to talk openly and freely about their care. Comments generally fell into a positive, negative or other category. Suggestions for improvement were sought and collated. Each patient was then invited to 'dot vote' for each option. This is a means of preference rating various options. Each patient was given ten sticky dots and could share these dots between the options in any way according to how important they felt the suggestion was to them.

A report was provided to clinical and managerial staff detailing the outcome of the focus group and individual interviews.

Sample of focus group outputs



Direct quotations recorded where possible

Dot voting exercise

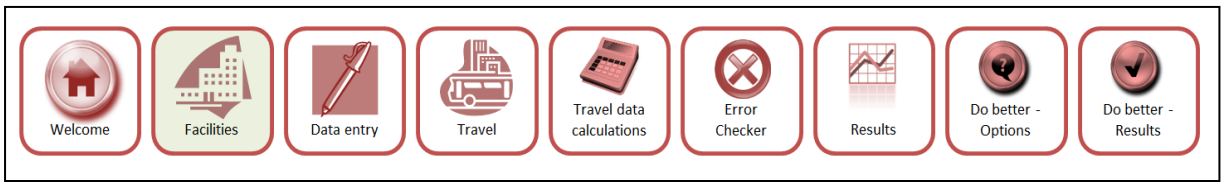
Feedback split into positive / negative / other categories

E – Tool screenshots:

Decision making tool

This is an optimisation tool, designed to assist with decisions relating to service redesign and resource/location allocation. It allows healthcare managers to more accurately plan future service specifications and ensure better informed decision making. While development was informed with input from ENT and Audiology, it was designed to be generic and applicable to any speciality.

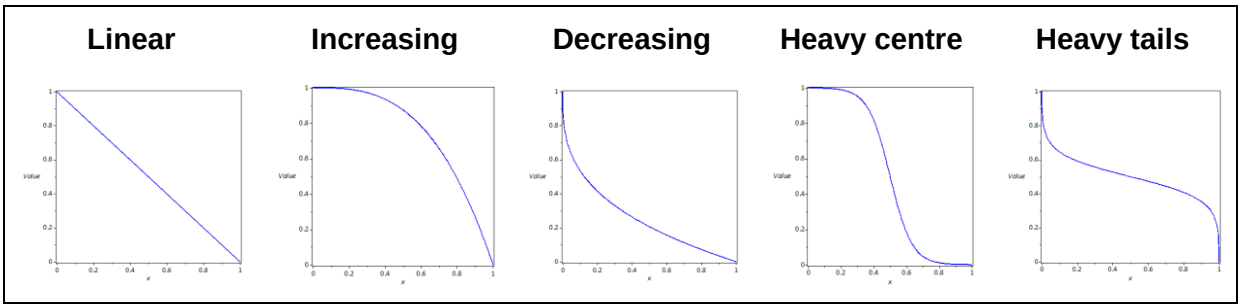
Easy to navigate tabs are included on the top of every sheet:



Welcome	General welcome and information sheet
Facilities	Number of current service, potential service and demand nodes entered. Names included but no other information at this stage
Data entry	Details of current service, potential service and demand nodes entered; for example, location, DNA rates, costs. Option to include comments which will enter into a qualitative report.
Travel	Mode of travel between current service and demand nodes; used to get travel costs and carbon footprint. Distances, carbon footprint and costs estimated from GIS tool.
Travel data calculations	Includes distances, costs and carbon footprint of travel between each pairs of service and demand nodes.
Error checker	Returns any errors if model is unable to run; for example, user has entered an incorrect postcode which is not recognised by GIS tool.
Results	High level results for current situation. Enables some simple 'what if' scenarios for the current set-up using sliders, changeable by each current service node; for example, impact on costs and numbers seen if DNA rate / treatment cost / transport costs changed.
Do better – Options	User chooses options to ask the model for a better set up of facilities, to include potential demand nodes, or simply to reallocate existing nodes. User chooses most important minimising objective; remainder are then scaled according to this. Minimising objectives are the **costs to the NHS, costs to patients, travel distance and carbon footprint***.
Do better – Results	Results from choosing 'do better' options. Result returned is measured in ReVS, a relative value score, on a scale of 0 to 100. Each variable is mapped to the same continuous scale to allow easy comparison between scenarios.

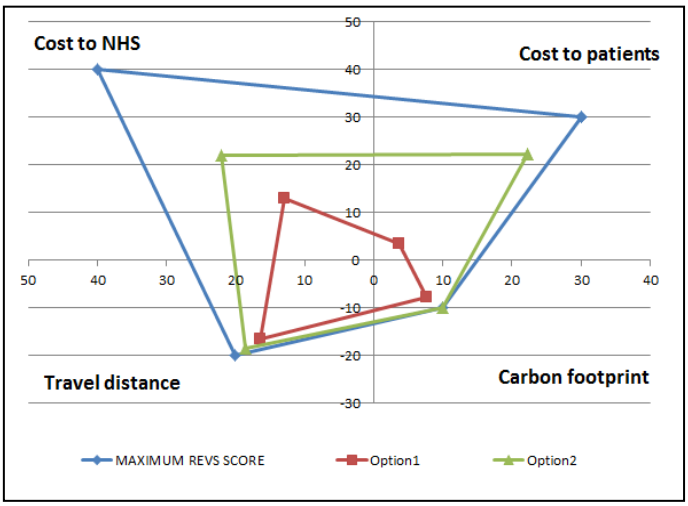
* Five **value functions** were created to allow a relationship between value and the minimising variable to be defined. For each criteria, value increases as the variable decreases, and thus the value functions are all decreasing.

The functions are displayed graphically below. Users can choose the relationship for each of the four minimising variables. This is a necessary step since it will not always be a linear relationship; for example, an initiative which reduces patient travel by five miles, from five miles to zero miles, may be considered to be more valuable than one which decreases travel from 50 miles to 45 miles.



The overall aim is to maximise the ReVS for a given configuration of demand and service locations.

Results include a detailed breakdown of each of the four minimising variables for each scenario tested. Graphs are also used to display these results in an easy-to-read format, see below for an example. The maximum ReVS is what would be achieved if, for each variable, the minimum was achieved. These scores always sum to 100. Within this polygon, results for different scenarios are displayed.

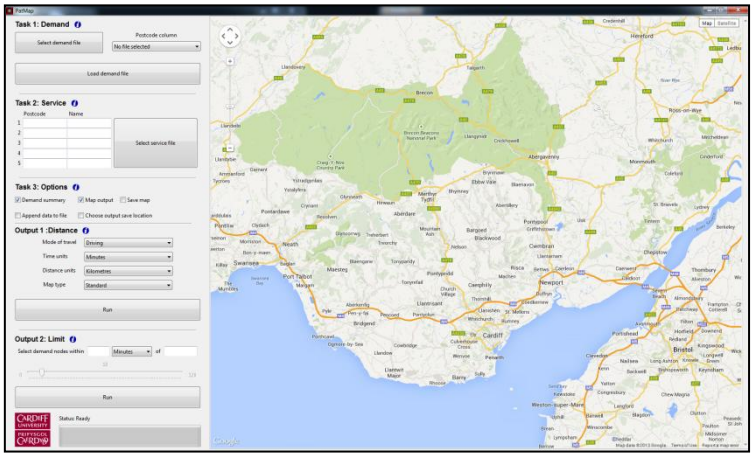


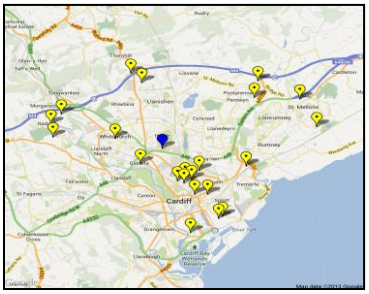
GIS mapping software

This software measures distances and travel times between demand and service locations in healthcare. Demand locations are typically patients' homes and service locations will typically be hospitals, clinics or other service providers.

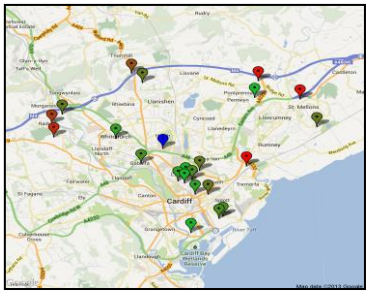
There are two main functions of the tool and in both cases, a Google Maps interface embedded within the tool allows for a visual representation of demand and service locations. Firstly, distances and travel times between demand and service locations can be calculated. The user has the option to select the mode of travel for these calculations; driving, walking or cycling. The imagery of the demand locations may be altered in order to reflect density of demand at the location. Secondly, the user can specify a driving time or distance limit, and calculate which demand locations are within the limit and which are not, for a user-selected service location.

This tool is titled *PatMap* (patient mapping).

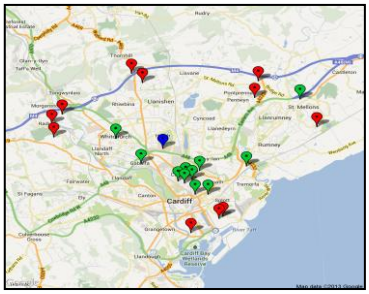




Standard map.
Demand nodes in yellow.
Service nodes in blue.



Heat map showing demand density. Demand nodes on gradated red (high) – green (low) scale.
Service nodes in blue.

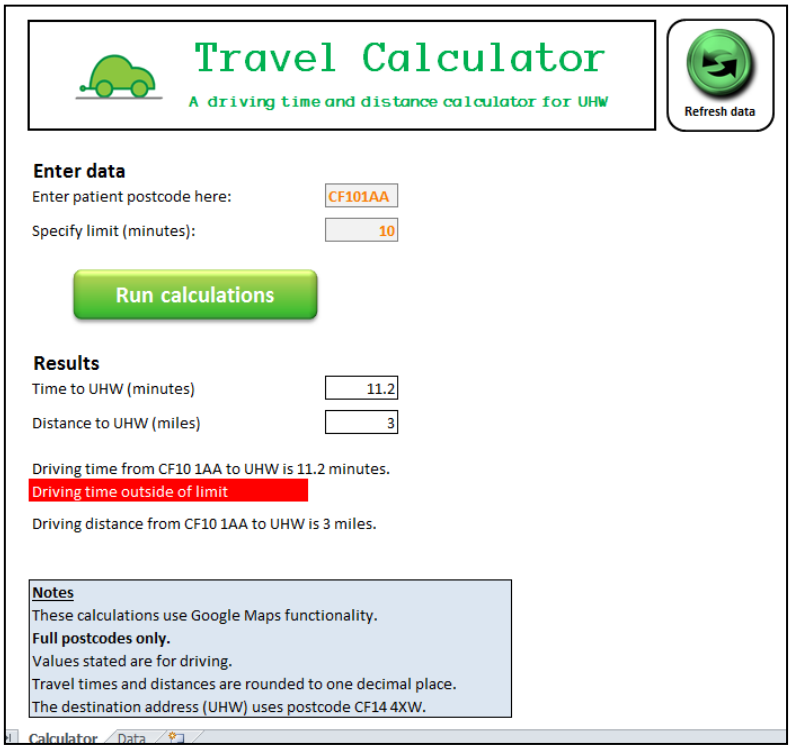


Radius map showing demand nodes within (green) or outside (red) a user entered limit (time or distance) of a service node.
Service node in blue.

Travel time and distance look-up tool

This tool provides a quick and easy method of determining the driving time and distance from a location to the University Hospital of Wales (UHW) in Cardiff. It uses data provided by the GIS mapping tool mentioned previously. It is designed for quick, one-off requests specifically to determine the driving time (in minutes) and distance (in miles) from a postcode to UHW. Whether or not a postcode is within a user-specified driving time (in minutes) of UHW is also returned.

To date, the tool includes over 20,000 unit level postcodes from the Cardiff area (covering all individual postcodes that are prefixed by the CF area code).

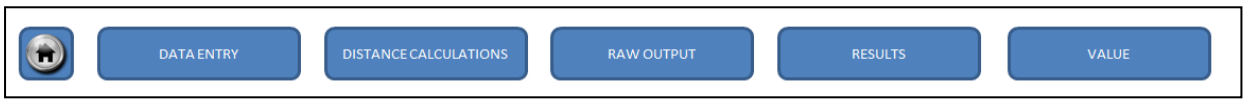


Value calculator

This tool follows a similar premise to the decision making tool, but is simpler and provides retrospective analysis only. Users can enter patient data and two service locations only. For each service location, various costs, distances and carbon costs are calculated to provide a comparison between the two sites. ReVS are also calculated.

This is a useful tool for decisions that have already been made, or to enable a quick method of a comparison between two sites. (Unlike the decision making tool, it does not optimise location allocation.)

Easy to navigate tabs are included on the top of every sheet:



Home	General welcome and information sheet
Data entry	Details of service locations and associated costs: geographical location, patient travel modes, travel costs, carbon costs, appointment costs, DNA rates.
Distance calculations	Reads in patient location data and calculates travel time and distances to the service locations, for each travel mode.
Raw output	Summary of all patient output.
Results	Overview of comparison for costs, carbon costs, travel measures, etc. ***See screenshot below.***
Value	ReVS calculations.

	SITE A	SITE B	CHANGE	% CHANGE
NHS costs				
Appointment costs	£5,250	£5,490	+£240	+ 5 %
Travel costs	£225	£0	-£225	- 100 %
All costs	£5,475	£5,490	+£15	+ %
Patient costs				
Travel costs	£2,298	£885	-£1,413	- 61 %
Distance travelled (miles)	8794	4214	-4,580	- 52 %
Travel time (hours)	47804.99	11983.00	-35,822	- 75 %
Carbon costs				
Appointment costs	2545	692	-1,853	- 73 %
Travel costs	1925	1290	-635	- 33 %
All costs	4470	1982	-2,488	- 56 %
Cost of service				
Fixed costs	£3,000.00	£5,000.00	+£2,000	+ 67 %
Variable costs	£2,250.00	£490.00	-£1,760	- 78 %
TOTAL COSTS	**£5,250.00**	**£5,490.00**	**+£240**	+ 5 %
Wasted costs	£300.00	£100.00	-£200	- 67 %
Carbon costs (kg CO2e)				
Fixed costs	1600.00	300.00	-1,300	- 81 %
Variable costs	945.00	392.00	-553	- 59 %
TOTAL COSTS	**2545.00**	**692.00**	-1,853	- 73 %
Wasted costs	160.00	6.00	-154	- 96 %

F – Presentations and conference contributions:

Cardiff and Vale UHB Faculty for Quality Improvement, April 2013 [oral presentation]

Presentation to Stephen Thornton, CEO of the Health Foundation, May 2013 [oral presentation]

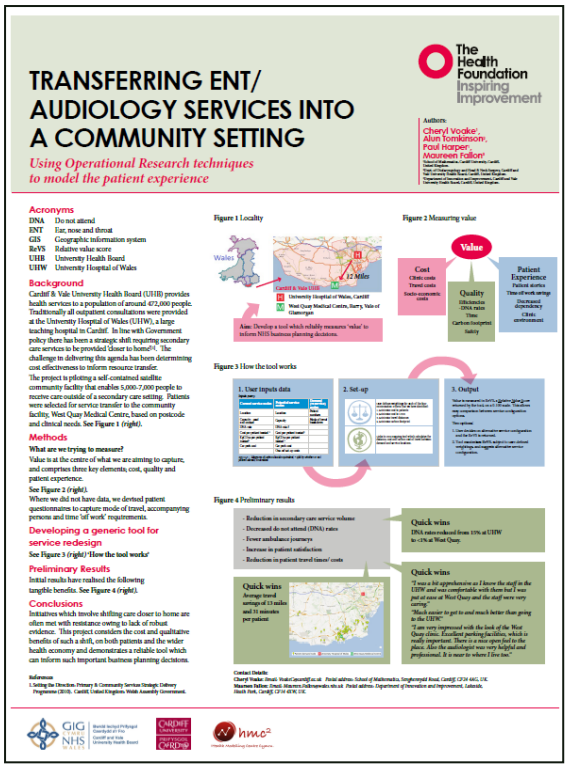
Operational Research Applied to Health Services conference, Istanbul, July 2013 [oral presentation with extended abstract]

The Operational Research Society annual conference (OR55), Exeter, September 2013 [oral presentation]

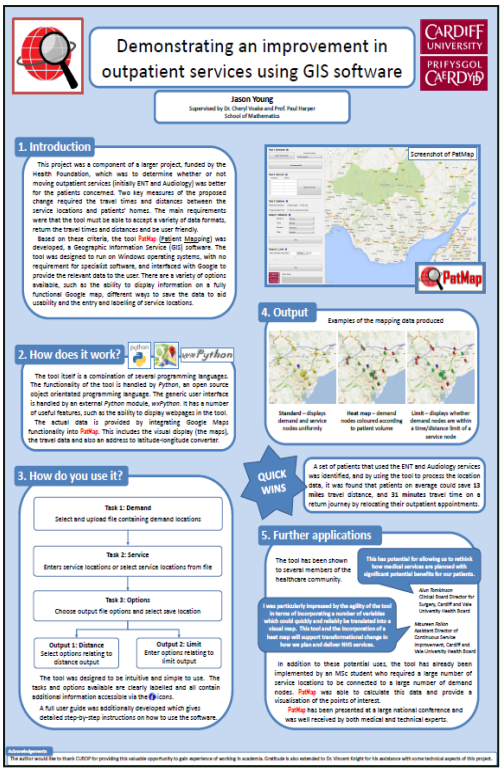
ISQua conference, Edinburgh, October 2013 [poster]

CUROP poster session, Cardiff University, October 2013 [poster]

ISQua poster (original size A0)



CUROP poster (original size A1)



We plan to present this work at the next ORAHS conference (July 2014).

G – Feedback to patients and action plan:

Making our patients aware that quality improvement exercises are being undertaken is extremely important. The most cost-effective and simplest way to achieve this is via posters / leaflets in clinic. Additionally, we wrote to all patients who took part in the patient stories programme or the focus group. This was to express gratitude for their involvement and to inform them of the clinic response to any issues raised.

Templates were designed to be used in clinic to feedback to staff. Where relevant, signs were also designed to be displayed in clinic to combat some of the issues raised. For example, patients requested access to water within the clinic, either via a vending machine or water cooler. The feasibility of implementation is under investigation (at the time of writing), but as an interim measure signs were designed to provide information on the location of the closest available water facility. Similarly, patients were unaware of the closest toilets and so signs were also designed to indicate the closest toilet facilities.

Feedback templates and examples