**Smart belt design for monitoring falls, posture and basic physiological parameters in the community**

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## Background

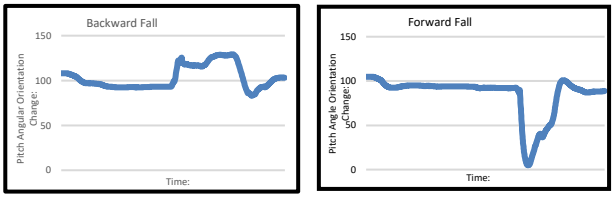
Aging population is a major concern for healthcare providers. There is a growing need to monitor people's health in the community to relieve pressure on acute service providers. The use of wearable devices in the community has gained significant attention in recent years due to rapid advances in technology. Research in the area shows that such devices can offer significant improvement to the general health and quality of life in elderly people. The adoption and uptake of this technology however remains relatively low due to the way people interact with the technology. The aim of this project is to design a practical, simple-to-use device that can be easily integrated into everyday life.

## Method

The prototype incorporated the use of an accelerometer, gyroscope and digital motion processor on a single chip, the size of a 10-pence coin. The device communicates via fast I2C protocol with minimal hardware requirements. An Arduino Nano Every microcontroller was used in this prototype with a 20MHz clock and a 48KB on-board flash memory. The Arduino unit communicates to nearby devices such as laptops or mobile phones via a Bluetooth plugin module. A graphical user interface (GUI) was developed in C# using the Unity Game Engine Integrated Development Environment (IDE). The prototype also incorporated a respiratory rate monitor using a conductive rubber stretch sensor, and a heart rate monitor using an integrated signal conditioning chip. The whole device was powered using a 9V battery and the cost of the components was less than £50. In order to test the performance of the device, simulation experiments were carried out using a test object and a human volunteer. Various digital filters were used to remove noise and correct for drift.

## Results

The linear quadratic estimation (LQE) filter performed best in removing noise and providing long-term stability for the posture/fall detector sensor. Simulation results showed that the sensor was successful in detecting falls as shown on the right. Respiratory and heart rate monitors also performed reliably with basic signal processing techniques.




## Discussion and Conclusions

Current state-of-the-art in microchip sensor technology and digital signal processing makes the development and utilisation of wearable devices solutions cheap and reliable. Future work is needed on data security and protection, data storage, power conservation and sustainability.

**Keywords:** Wearable devices, fall detection, posture, home monitoring

**Enhancing Medical Physics Operations with ChatGPT 4.0 Today: Capabilities and Considerations**

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***Abstract – Case study of experience no more than 1 page in Arial 11 point, presenting speaker underlined***

**Abstract: Enhancing Medical Physics Operations with ChatGPT 4.0 Today: Capabilities and Considerations**

The adoption of artificial intelligence tools like ChatGPT 4.0 in medical physics departments represents a forward step in refining operational processes and data analysis and generating major efficiency savings. This presentation will explore the application of ChatGPT 4.0 as an adjunctive resource across a spectrum of tasks within medical physics. Key focus areas include data processing & visualisation, workflow optimisation, and quality assurance measures, with specific examples such as gamma analysis, DICOM handling, and analysis of (anonymised) patient pathway data. Some current limitations of ChatGPT will also be discussed, underlining the importance of human oversight and the caution required in an environment with medical devices.

Furthermore, we will examine the utility of ChatGPT 4.0 in routine departmental activities such as project planning, minuting meetings, and code generation & debugging. The discussion aims to underscore ChatGPT's function as a collaborative tool, which supports medical physics professionals by automating routine tasks, thereby reallocating focus towards direct patient care and research.

The talk aims to showcase the potential of ChatGPT to contribute to departmental efficiency and innovation, all the while advocating for the indispensable nature of human expertise and the irreplaceable role of traditional medical devices.

## Is there a role for non-UKCA marked smart technology in the modern NHS?

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**Background:** Smartwatches have experienced a surge in popularity within the general population in recent years. It was predicted that 109.2 million devices will be sold globally by 2023 (Siepmann and Kowalczuk, 2021). Many of these devices use photoplethysmography to track physiological data, making them an important tool for health monitoring. The objective of this project was to investigate potential differences in accuracy between smartwatches that are registered as medical devices and those that are not.

**Method:** The heartrate measurement taken by the watch was compared with those taken by a Philips MX450 monitoring system which is used in a clinical setting for measuring SpO2 and heart rate using photoplethysmography. 15 participants [60% male] were asked to sit at rest for 10 minutes before engaging in a 3-minute exercise session. Heart rate data was collected from both the patient monitor and the smartwatch at 30-second intervals. Participants were classified according to their Fitzpatrick skin tone, age, and BMI to examine the potential impact of these variables on the results.

**Results:** This study revealed significant variations in accuracy among different smartwatches. During exercise, the difference in readings between the patient monitoring system and all smartwatches were much greater than during rest This discrepancy was attributed to artefacts present on both the patient monitoring system and the smartwatches, with sweat likely being the primary culprit for these inaccuracies. Figure 1 and Figure 2 show that when the Samsung Galaxy Watch4 and Google Pixel Watch were compared to the patient monitoring system, the Samsung Galaxy Watch4 showed greater accuracy as the confidence intervals were significantly smaller. This watch is UKCA marked for it's blood pressure monitoring feature which uses the same photoplethysmography hardware as the heart rate function, whereas the Google Pixel Watch is not UKCA marked as a medical device.

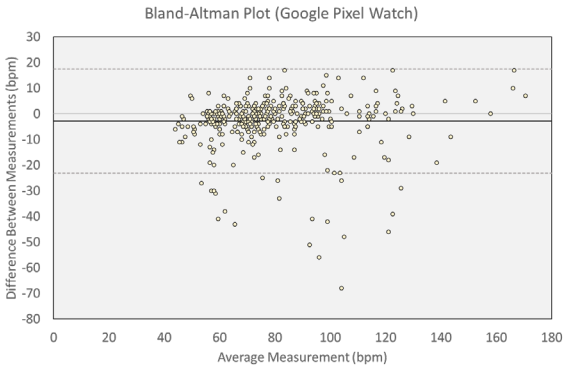


*Figure 1 Bland-Altman Plot for Google Pixel Watch*

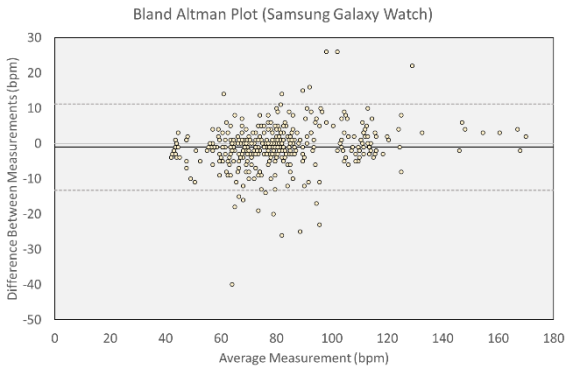


*Figure 2 Bland-Altman Plot for the Samsung Galaxy Watch4*

**Discussions and Conclusions:** Whilst there is more work to be done, early stage results indicate that there is a difference in the accuracy of smart devices with a component UKCA marked as medical devices when compared to those that are not UKCA marked. This suggests that it may be reasonable to use the measurements from these devices in the diagnostic process in the future assuming differences of ±10 bpm are clinically acceptable.

**Keywords:** smart devices, pulse oximetry, CE marking, medical devices, physiological measurements

**References:** Siepmann, C. & Kowalczuk, P. (2021) Understanding continued smartwatch usage: the role of emotional as well as health and fitness factors. *Electronic Markets*. [Online] 31 (4), 795–809.

**Analysis of independent dose calculation and measurement systems in clinical use for patient specific quality assurance.**

**Background:** Patient specific quality assurance (PSQA) is an essential part of a comprehensive QA program. It is therefore imperative that the limitations of the independent dose calculation and measuring systems used for PSQA are well understood. In this project, we will investigate the dosimetric differences between the PSQA systems currently in clinical use in Bristol Haematology and Oncology Centre (BHOC). We will also evaluate the sensitivity of the measuring systems in detecting errors in the treatment plans.

Independent verification of the treatment planning system (TPS) dose is recommended in numerous publications including IPEM Report 81 [1], Towards safer radiotherapy [2], AAPM task group 219 [3] and the NHS service specification for external beam radiotherapy.

In BHOC, independent dose calculation of treatment plans is performed using two different pieces of software: one which utilizes a collapsed cone convolution (CCC) algorithm namely Compass, and a novel system which utilizes concepts of virtual Monte-Carlo codes namely myQAion. Both systems compare the TPS dose against the independently calculated one by performing gamma analysis with predefined gamma criteria.

If a plan fails the gamma analysis, then the next step is to deliver the plans to a radiation detector to investigate its deliverability. Two different types of detectors are used in BHOC, an ion chamber array detector (MatrixX, IBA) and a novel CMOS (complementary metal oxide semiconductor) detector (SRS detector, IBA).

This process can be time consuming, taking between 20 minutes and several hours. Moreover, literature is conflicting about the benefit of plan measurement for certain patients. McKenzie *et.al.* compared the performance of PSQA detectors and concluded that some of them could not distinguish between acceptable and unacceptable plans [4]. Additionally, Han *et.al.* observed dosimetric and gamma passing rate differences between measurement-based and independent dose calculation based PSQA and concluded that care must be taken when considering replacing the former by the latter [5]. It becomes apparent that there is no unanimous consensus as to what method of PSQA is most appropriate for each treatment plan which can lead to delays in the patient pathway.

**Methods.** SABR clinical plans of high complexity will be computed using the same calculation parameters in the treatment planning system (TPS) Raystation and in the independent dose calculation systems Compass and myQAion. Plans will be validated by measurements performed on the MatrixX and the SRS detector. The results will be analysed in the following way:

- The Raystation, Compass and myQAion doses will be compared to each other by means of gamma analysis and volume dose differences. The gamma analysis will be performed in the Compass and myQAion systems and independently in another dose evaluation system (myQApatients).
- The calculated doses will be compared against the dose distributions measured by the two detectors, via means of gamma analysis.
- The sensitivity of each detector will be evaluated by their ability to identify errors which will be introduced in clinical plans (i.e. MLC position errors).
- The complexity indexes calculated by myQAion will be analysed against the measurement results for each plan with the aim of establishing whether there is a statistically significant correlation between them which would allow us to use them as a predictive tool for plan measurement.

**Results**. This is an STP Master's project with full results expected May 2024. Preliminary results for the independent dose calculation systems show that there is a statistically significant difference in the doses calculated by them, but further analysis is needed before any concrete conclusions can be reached.

| myQAion | Compass |
|---|---|

| Mean PTV dose difference (%) | Standard deviation of PTV dose difference | Mean PTV dose difference (%) | Standard deviation of PTV dose difference |
|---|---|---|---|
| 0.59 | 0.85 | 3.18 | 1.17 |

**Conclusion.** The results of this project hope to help streamline the PSQA process in our department thus making it less time consuming and more reliable so that we can provide the best possible quality of care to our patients.

**Key references**.


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[3] AAPM Task Group 219, "Report od AAPM Task Group 219 on independent calculation base dose/MU verification for IMRT," Medical Physics , 2021.

[4] E. McKenzie , P. Balter, F. Stingo , J. Jones, S. Kry and D. Followill, "Toward optimising patient spedific IMRT QA techniques in the accurate detection of dosimetricaly acceptable and unacceptable patient plans," Medical Physics, 2014.

[5] C. Han, J. Yi, Y. Ai and X. Zheng, "Cross verification of independent dose recalculation, log files based and phantom measurement based pre-treatment quality assurance for volumetric modulated arc therapy," *Medical physics ,* vol. 21, pp. 98-104, 2020.

**Title of Study** Development of phantoms and a quality assurance protocol for a multi-centre abbreviated magnetic resonance imaging breast study.

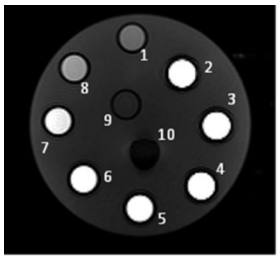
[1]Siân Curtis, [1]Holly Elbert, [1]Jonathon Delve, [1]Sam Stewart-Maggs, [2]Anna Wang, [3]Liz O'Flynn, [4]Sadie McKeown-Keegan,[5]Maria Schmidt, [6]Mark Halling-Brown, [7]Sarah Vinnicombe,[4]Lyn I. Jones on behalf of the FAST MRI Study Group.

*[1] University Hospitals Bristol and Weston NHS Foundation Trust, [2] University of Oxford, [3] St George's University Hospitals Foundation Trust, [4] North Bristol NHS Trust,[5] Retired -Royal Marsden NHS Foundation Trust and Institute of Cancer Research,[6] Royal Surrey County Hospital NHS Foundation Trust, [7] Gloucestershire Hospitals NHS Foundation Trust*

**Background:** Previous studies have indicated that aggressive cancers, not well visualised on mammograms, can be identified on an abbreviated magnetic resonance imaging (MRI) breast protocol called FAST MRI [1-5].

The aim of this study was to design and develop prototype phantoms for contrast-weighting and geometric evaluation of abbreviated breast MRI sequences. The phantoms form the basis for standardised quality assurance (QA) testing in a multi-centre FAST MRI study.

**Methods:** A contrast phantom was developed by testing the responsiveness of MRI contrast agents to small changes in clinical sequence parameters and assessing their stability and reproducibility (Figure 1a and 1b). A geometric phantom was developed by investigating different construction methods and target designs with comparison to expected clinical scan parameters (Figure 1c). The phantoms were assessed on clinical MRI scanners used in the NHS breast screening programme for women at high risk and used to develop a FAST MRI QA protocol.

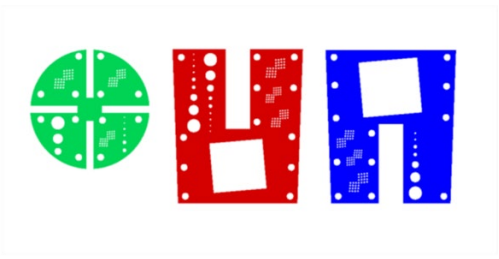
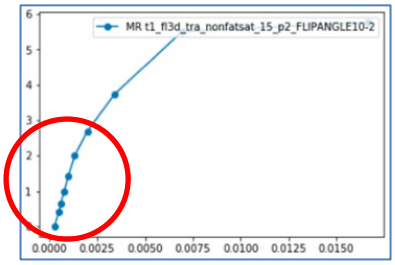



**Figure 1a** Contrast phantom **Figure 1b**T1W MRI image **Figure 1c** Geometric phantom design

**Results:** For the contrast phantom measured T1 values agreed with the literature for Gadolinium and Nickel Chloride solutions and signal enhancement showed strong sensitivity to changes in clinical sequence parameters (Figure 2a). For the geometry phantom a design was chosen which included a range of resolution test targets to allow swift visual evaluation and in-depth analysis and performance tracking (Figure 2b). Visual inspection and analysis of the MR images indicate the phantoms are suitable for use in a FAST MRI QA protocol to assess contrast-weighting and geometry.



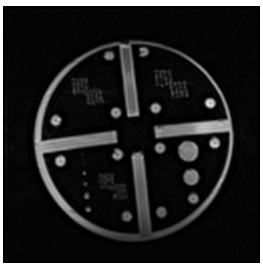



**Figure 2a** Signal enhancement vs 1/T1 **Figure 2b** T1W image of geometric phantom

**Discussion:** The phantoms are relatively inexpensive, easy to set up, fit inside a standard breast MRI coil and are suitable for MRI radiographer-led QA.

**Conclusion:** Two dedicated phantoms and a standardised QA protocol were designed and developed as part of the QA programme for the FAST MRI study. The phantoms and QA protocol have the potential to be incorporated into NHSBSP technical guidance for MRI equipment quality assurance testing.

**References: 1.** Geach et al, Clinical Radiology. 2021; 76(2): 154.e11-154.e22. **2.** Kim et al, Radiology 2022;305:36-45. **3**. Kuhl et al, J Clin Oncol, 2014; 32:2304-2310. **4.** Pham et al, AJR 2020;215:765-769. **5.** Vinnicombe et al. Clinical Radiology. 2021; 76(6): 427-433.

**Key Words:** abbreviated MRI, phantoms, quality assurance, breast screening, FAST MRI

**Optimising bone scans using SwiftScan technology**

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## Background

The need for optimisation of patient dose is set out internationally as a fundamental of radiation protection by ICRP [1], and in UK legislation within IR(ME)R [2]. To comply with this, the acquisition of a new NM/CT Discovery 870 gamma camera within Gloucester Hospitals NHS Foundation Trust provided the perfect opportunity for optimisation as it came with SwiftScan technology. SwiftScan has been shown to optimise patient outcome by allowing a reduction in imaging time or dose whilst maintaining an appropriate image quality [3, 4]. The possibility of reducing acquisition time without compromising image quality is of particular importance within bone scintigraphy, as it is one of the most commonly undertaken scans within nuclear medicine departments and hence represents a significant proportion of the clinical workload [5, 6]. Therefore, being able to reduce the time per scan can have a large time benefit to a department, making it the perfect candidate for optimisation, and the focus of this research.

## Methods.

Initial results were collected using nuclear medicine quality assurance phantoms to investigate the impact of changing acquisition time and applying SwiftScan technology on final image quality. The images collected were assessed qualitatively, and then quantitatively looking at the change in CNR and coefficient of variance. These results were used to support a set of new parameters to be applied clinically. Two case studies were chosen for this research. These patients had images taken initially using the standard bone scan protocol at use at GHNHSFT. The new protocols were then applied and the patient imaged again. The set of images for each patient were compared against each other as a direct comparison between old and “optimised” settings. This evaluation was done quantitatively by a physicist and then qualitatively by a reporting radiologist. A final image optimisation team consisting of physicists, radiologists, and radiographers then met to discuss the results and formulate an optimised protocol for bone scan patients to be used within GHNHSFT.

## Results

There are no final results for this research project as it is still in progress with a completion date of early May 2024.

## Key references

[1] – ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4)
[2] – Regulation 12, The Ionising Radiation (Medical Exposure) Regulations 2017, (2017 no. 1322). Available at: https://www.legislation.gov.uk/uksi/2017/1322/contents/made (Accessed: 8/1/24)
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# *Refinement of IRAT2 – 'Up Sewage Works Creek'*

## *Aims and background*

The Royal Cornwall Hospital discharges via a sewage works on a tidal river.

A proposed change to our discharge limits was evaluated using the Initial Radiological Assessment Tool 2 (IRAT2). This indicated annual doses to Anglers in the region of 1200 µSv (well above the screening criterion of 20 µSv per year) and a sewage treatment works (STW) worker dose of 33 µSv per year. The model needed to be refined to fit reality and ensure that doses to exposed persons were actually (as common sense suggested) below the screening threshold.

## *Methods:*

The aqueous discharge of P-32 (the main culprit) was reduced by three quarters through the use of annual (as opposed to monthly) discharge limits, but the dose to Anglers was still high at 470 µSv per year.

The model was refined for river flow rate, fish consumption and working behaviour of sewage treatment workers. The first of these involved investigation of the tidal patterns at the discharge point of the STW and conversations with CEFAS (Centre for Environment, Fisheries and Aquaculture Science). IFCA (Inshore Fisheries and Conservation Authority) advised on the consumption of fish by local anglers and finally South West Water kindly engaged with the physics team regarding working habits of their employees. This work also involved various site visits to the picturesque rivers and shorelines (and STW) of Cornwall.

This information was used with the Environment Agency (EA) guidance on IRAT2[(a)] to tailor the calculation model for the specifics of the discharges from the Royal Cornwall Hospital.

## *Results:*

After extensive finessing, the maximum dose to any person of interest was below the screening criterion of 20 µSv per year.

## *Discussion*:

IRAT2 is a screening tool and as such is designed to provide a conservative assessment. Making changes to the model is sometimes necessary, however this is not a straightforward process.

## *Conclusion*:

Awaiting verdict from EA.

## *Key words:*

Initial radiological assessment tool, IRAT, Environment Agency, Permit amendment

(a) *Initial Radiological Assessment Tool 2: part 2 methods and input data, EA 2022 https://assets.publishing.service.gov.uk/media/63528573d3bf7f1943006c60/Initial_radiological_assessment_tool_2_-_part_2_methods_and_input_data.pdf accessed March 24*

Chloe Trevail 2024

**Reviewing a Major Incident Plan for Contaminated Casualties from a Naval Base arriving at an NHS Hospital, and Liaison between NHS, MoD and Babcock physicists**

Katharine Thomson[1], Hannah Gill[2], Corey Lyth[1]
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[2]Babcock International Group, Devonport Royal Dockyard

**Background:** HM Naval Base Devonport and Babcock International's Devonport Royal Dockyard jointly form the largest naval support site in Western Europe. Babcock's facilities include the UK's only licensed site for refitting and refuel of nuclear-powered submarines, including Trafalgar and Vanguard-class submarines. Derriford Hospital in Plymouth would be the receiving trauma centre for any contaminated casualties in the event of an incident at Devonport. Derriford has a Major Incident Plan for receiving potentially contaminated casualties should such an incident occur. Ownership of this is held by the Clinical & Radiation Physics (C&RP) group, with oversight from clinical scientists/RPAs/RWAs within Nuclear Medicine.

The Babcock International Emergency Planning Group based at Devonport has an extensive emergency responder call out list, with certain roles requiring a 24/7 presence on site. Physical resources include dedicated emergency response facilities, vans equipped with monitors and the capability for the decontamination of personnel . By contrast, the C&RP Emergency Call Out list consists of eight people, half of whom do not live in Plymouth, and typical monitoring equipment for a hospital Nuclear Medicine department.

**Processes:** A strong working relationship has built up over time between C&RP and the Devonport Emergency Planning Group. With staff turnover and periodic reviews of practices, we felt that it was important to build stronger links, better communication and greater understanding of each other's procedures. The Derriford contingency arrangements are reviewed and updated every two years. At the latest review, the receiving medical theatre was in the process of being demolished, therefore part of this review involved the designation of a suitable theatre to receive a critically injured contaminated patient, whilst reducing the impact to the rest of the hospital. We further considered the likely support available from medical physics personnel in the event of an incident, and how skills from different staff groups could be best utilised to support monitoring, decontamination and limiting contamination spread.

**Lessons Learned:** We considered security implications and realistic staffing scenarios for out of hours incidents. We walked through areas of ED and Theatres with local staff to ensure viability of plans. We sought help from the Babcock Emergency Planning Group to discuss handover arrangements for contaminated casualties and likely scenarios.

**Best Practice:** Several familiarisation visits took place, both for hospital staff to visit the Naval Base and vice versa. Babcock/MoD staff were taken on tours of relevant areas of the hospital to better envisage realistic enactment of the plans. UHP staff visited the Devonport site and watched contingency plan rehearsals. Additionally, we set up a secondment placement scheme for a Babcock Health Physics trainee at Derriford Hospital to help us review our plans and provide insight into what would be expected from an incident at Devonport.

**Conclusion:** This presentation will discuss an outline of the actions involved when enacting the plan, and how the Derriford Hospital physicists has learned from Babcock and MoD colleagues. A particular highlight was the secondment placement scheme which we hope to run in the future.

**Title of Study** **Use of a 3-D Printer in Medical Physics and Clinical Engineering - A money maker/saver for your Trust?**

Submitters details
Jonathan Fowler, Senior Clinical Technologist, Medical Physics, Dorset County Hospital;
Jim Thurston, Head of Medical Physics

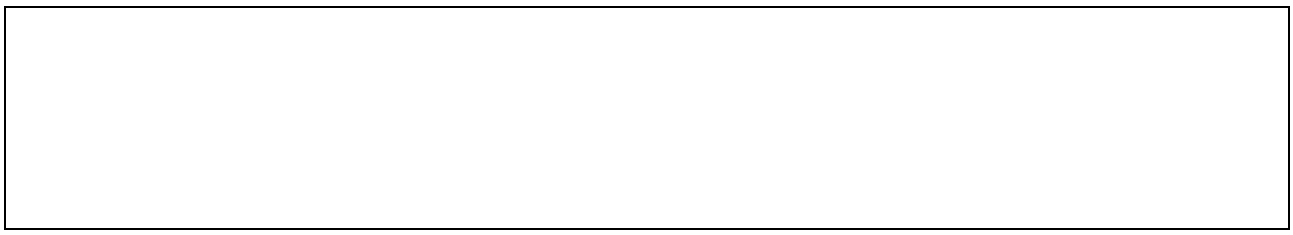
***Abstract no more than 1 page in Arial 11 point, presenting speaker underlined***

The presentation will detail work using a 3-D Printer (the Ultimaker 3 Extended) undertaken for, or in conjunction with, our Clinical Engineering Department.

The Printer was purchased with some "year-end" money which was made available at very short notice. Little use was made of the device for several months until a couple of students on the Government's Kickstarter programme joined Clinical Engineering on a 6-month work placement. At the time there was a spate of broken syringe driver/infusion pumps around the Hospital, the root cause being established to be at least in part due to a design weakness in the syringe driver "Space Station" stack system.

This presentation will detail how a solution was developed for this problem. Firstly a basic design for a baseplate to be fitted to the stack was first developed using CAD (cardboard aided design). The Kickstarter students then imported this into virtual space with a 3D modelling programme. Various prototypes were created with the 3-D printer and the design adjusted, until a final version was produced which went into "production" for a total of about 50 units, costing about £4 each in material to print. Given that each broken pump costs £300-£400 to repair or £800 - £1500 to replace, this cheap solution will potentially save the Trust substantially on its medical devices repair/replace budget.

Since then, numerous items have been designed and produced (without cardboard aided design) to repair, replace or create parts, or indeed entire devices, saving the Trust thousands of pounds each year. They will also be discussed in this presentation.



# Uses and misuses of statistics

Azzam F. G. Taktak

Clinical Engineering, University Hospitals Bristol and Weston NHS FT

**Abstract**

The use of statistics in scientific literature is commonplace especially in the medical field [1,2,3]. It is very rare to find a scientific article that does not contain some element of study design or statistical analysis. And yet, the teaching of statistics often does not stretch beyond a very basic level. Given the complexity of the subject, it is not surprising that scientific literature is full of flaws and errors in the use of statistics. Moreover, researchers may in some cases either deliberately or inadvertently influence their results to fit with their belief. This is sometimes satirically termed as "massaging data" or "torturing data until they confess".

Some of the common pitfalls during the study design stage include lack of power calculations or an appropriate control arm for example. The use of retrospective data is often preferred for convenience and for financial reasons. The accuracy of retrospective data cannot however be guaranteed, and they are often incomplete. Dealing with missing data is not straight forward and can lead to skewed results if handled inappropriately. At the analysis stage, one of the most common errors is not checking assumptions (such as normality of data) or treating categorical data as ordinal data, thus imposing spurious order to them. When presenting the data, errors often occur when the researcher does not indicate uncertainty (again unintentionally or deliberately) or using the wrong tools to display the results.

In this talk, I will present real-world examples illustrating the points above, how to spot them and how to avoid them. Participants will also have the opportunity to test their knowledge by taking part in an interactive quiz.

**References**

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# ***"Is the use of RapidPlan™, Model for lung SABR dosimetrically and practically viable at the local centre?"***

*Sarah Weeks*

*Senior Dosimetrist Royal Devon University Healthcare NHS Foundation Trust*

There has been an increase in the use of Artificial intelligence (AI) in radiotherapy over the past decade with it being used in numerous parts of the clinical workflow. Since 2011 there has been a steady increase in Knowledge based planning (KBP) studies in the literature, showing a growing interest in its use and clinical implementation (Ge and Wu, 2019).

Radiotherapy is a key part of cancer treatment with approximately 50% of all cancer patients having radiotherapy (Momin et al, 2019), with increasing patient numbers and plan complexity in radiotherapy, the use of AI tools is becoming more attractive and used with increasing frequency.

Stereotactic Ablative Body Radiotherapy (SABR) requires extensive planner experience, knowledge and can be time consuming. KBP can address the issues of plan consistence, quality as well as provide significant time savings. When introducing a new technique planning comparison studies can provide powerful information before the technique is used clinically.

The development of KBP model requires careful plan selection, training and testing to ensure a high quality model is developed, a model needs to be able to handle different clinical scenarios to be robust for clinical use.

For this service development a lung SABR Rapidplan ™ model was tested comparing it to manual plans created by an experienced planner, to justify and demonstrate the efficacy, efficiency and safety of its use before being implemented clinically.

A quantitative retrospective planning study was carried out using a stratified sample of 30 previously treated lung SABR patients' data who met the inclusion criteria. Plans were created using the Eclipse™ Rapid Arc licences for the manual plans, and KBP using a Rapidplan™ licence lent to the researcher by Varian Medical Systems, with the Lung SABR model lent from the Rapid plan™ consortium group was used within the same Eclipse ™ planning system. ™ Domestic data for planning target (PTV) coverage, dose conformity metrics and organs at Risk (OAR) were recorded as well as the number of iterations for manual plans. All plan were the checked for deliverability by being delivered on the linear accelerator in quality assurance (QA) mode using an EPID-based patient specific QA. The data was recorded and analysed with and a statistical Paired T-test carried out with a p value of 0.05 chosen for statistical significance.

The study demonstrated that Rapid plan™ could produce comparable plans to that of manual plans by an experienced plan with 93.3% of the plans being clinically acceptable within one optimisation, meaning all PTV coverage, plan quality metrics and mandatory OAR constraints were met. All clinically acceptable plans were deliverable on a linear accelerator evidenced by the machine QA completed got this planning study. The study showed a timesaving in terms of number of optimisations using RapidPlan™ and a potential for improved consistency but this would need further investigation and a time and motion study could provide more accurate time saving data. In conclusion the results of this planning study would support the implementation for Rapid plan™ with the lung SABR model to be used clinically at the local centre.

Key Words Artificial Intelligence, Knowledge based planning, Rapid Plan™ , Lung SABR.

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**X-ray field sizes, a marginal problem?**

Nathan Kimball-Smith – Trainee Clinical Scientist

**Aims/Background**

Since the continued removal of film screen and Computed Radiography (CR) image phosphor plates, Medical Physics Departments now need to consider alternatives when measuring x-ray margins for quality assurance purposes. The purpose of this study was to identify realistic and practical alternatives to CR in routine quality assurance.

**Methods**

A review of the literature was conducted to identify potential replacement methods, which were then peer reviewed before testing. Several methods were tested in the department testing facility with further verification measurements on clinical systems in diagnostic rooms. A breadth of imaging modalities using x-rays were tested.

The use of digital radiography was considered including an independent digital radiography (DR) plate and one tethered to a mobile unit or fixed room. A radioluminescent ruler was obtained on loan from a supplier and tested, checking for readability and presence of light output after termination of exposure. An electronic x-ray ruler designed to measure field edges currently owned by the department was tested with the assumption that field size can later be inferred from these measurements using a separate physical rule, the sources of errors were also analysed. Measurements taken with the electronic x-ray ruler were analysed against digitally scanned exposures on gafchromic film.

**Results**

CT measurements of slice width using the digital ruler varied from -1.9mm to +1.8mm difference from digitally analysing the penumbra's full width at half maximum of the gafchromic film exposure, over a range of slice thicknesses from 1.25mm to 20mm. The difference from human eye inspection of the film to the digital analysis ranged from -0.1mm to -0.7mm.

Preliminary results from mammography measurements highlighted large setup error placing the sensitive area of the device on the nipple edge of the field, with the left right and chest wall edges of the field being up to 2.5mm different than the gafchromic film measurements.

**Conclusion**

Independent DR plates are financially restrictive and can be ruled out while a tethered DR system was found to be viable solution but considered not ideal due to the coordination involved and potential damage and high costs to repair/replace the DR plate. The use of a radioluminescent ruler from the specific supplier was found to be unsuitable.

The use of the electronic X-ray ruler for CT is likely not fit for purpose. A longer study is needed to validate the preliminary results of the mammography exposures to make a definitive judgement on suitability, however it has been shown that the accuracy of the measurements is likely to be suitable enough in mobile X-ray units measuring field edges and determining whether the field falls entirely on the detector.

**Key Words**

Imaging, Quality Assurance.

**Experience, guidance and feedback on the Higher Specialist Scientist Training (HSST) final Independent Assessment of Professional Skills (IAPS) process**

Paul A Evans, Director of Medical Physics and Clinical Engineering, Royal Devon University Healthcare and Torbay and South Devon NHS FTs

## Background

The National School of Healthcare Science (NSHCS) HSST programme (1) has now seen 10 new cohorts enrolled on the programme since its inception in 2014, across all c.50 Healthcare Science (HCS) specialisms. As part of the outcome assessment after the nominal 5 year course duration and during the sixth year, there is a final viva style examination termed the IAPS (2). There have now been 9 iterations of IAPS, which usually take place every 6 months (May and November), since the first HSST exit cohort in 2019. Feedback from professional HCS groups, candidates and supervisors still indicates a relative lack of familiarity with the IAPS process and how departments can best prepare their own candidates for success. This presentation is an attempt to improve the collective understanding of navigating the IAPS process, from evidence submission to examination, based on the experiences of a lead and panel examiner for IAPS from the first cohort in 2019 to the present.

## Presentation

A brief introduction to the HSST programme will be given. Attendees will then be reminded/briefed on the structure/process of IAPS, what showcase evidence is required to be submitted and how this is assessed against the HSST five domains of Good Scientific Practice (3). A review of the outcome pass/fail possibilities will be given, including the mechanisms, tiers and numbers of resits possible. Results from the first cohorts of IAPS will be also be discussed, with pass rates and breakdowns of failures across different HCS specialisms, but with particular reference to Medical Physics and Clinical Engineering.
Secondly advice will be given to candidates/supervisors on how to generate opportunities to work at entry Consultant Clinical Scientist (CCS) level in their training plan and on how best to select/present this evidence with maximum clarity and effectiveness, so it closely matches to the domain standards. Preparing for the scientific paper component of IAPS and recommended strategies for critically appraising it, will also be covered, together with advice on how to approach the implications of local implementation (or if not why not) at threshold CCS level.
Finally, practical advice will also be given to HSST supervisors on how best to prepare HSST candidates so as to maximise their chances of success in their IAPS.

**Key Words**
Higher Specialist Scientist Training, Independent Assessment of Professional Skills, Consultant Clinical Scientist training.

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**Update on the RaPIDE study (RAman Probe for In vivo Diagnostics (during oesophageal) Endoscopy)**

Catherine Kendall[1,2], Oliver Old[1,2], John Day[3], Alex Dudgeon[1,2], Nick Stone[1,2]

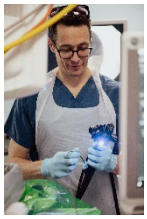
[1]Gloucestershire Hospitals NHS Foundation Trust, [2] University of Exeter, [3] University of Bristol

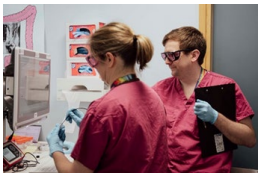
**Background**. The aim of the RaPIDE trial (RAman Probe for In vivo Diagnostics (during oesophageal) Endoscopy) was to use a novel miniature device in-vivo to demonstrate whether it is safe and reliable for use in patients, taking this technique from the laboratory to the clinic. This is an update on the project presented as a plenary talk at SWMPCE meeting in 2023. Previous lab-based studies have demonstrated that using a technique known as Raman Spectroscopy can be used to tell the difference between healthy and diseased tissue[1-8]. When tissue is illuminated with a low-power NIR laser the inelastically scattered light can be used to provide biochemical information and thus information about its disease status.

**Methods.** A probe was developed to slide through the biopsy channel of an endoscope to shine light onto the surface of the oesophagus & provide additional information to the clinician, using Raman spectroscopy, potentially removing the need for biopsies.

Following approval of the Raman probe as a medical device by the MHRA & receipt of ethical approval for the research trial from the HRA the first patient was recruited to the trial in September 2023 at a routine visit to the endoscopy department. Raman spectra were measured in up to 5 locations affected by a pre-malignant condition called Barrett's oesophagus, with spectral acquisition times of 10-30s. A suction camp was used to maintain the position of the endoscope whilst the Raman probe was retracted and replaced with standard biopsy forceps for the collection of a tissue sample for routine histopathological review. Spectral data was reviewed in conjunction with histopathology results.

**Results**. An initial cohort of 5 patients were recruited to assess the safety of using the Raman probe at endoscopy and undertaking spectral measurements. The probes were successfully passed down the endoscope and spectral data was measured in-vivo. No damage due to laser illumination of the tissue was reported by the histopathologist. A further 20 patients were recruited to the study which concluded at the end of April 2024 when all the manufactured probes had been used.





**Discussion & Conclusion.** The RaPIDE trial has shown it is safe and reliable to use the Raman probe in-vivo, which takes this technique a step closer to translation from the lab to the clinic & additional patient benefit. This is a significant step forward in the development of Raman spectroscopy as a tool for clinical diagnostics.

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# Oncology Workshop Clinac Maintenance Management

**A brief overview of Varian PMP (Planned Maintenance Program) and Redmine our equipment fault and maintenance recording platform.**

An overview will be provided of the Varian provided software tool, HETTool, and how this is used in the department to plan and record Clinac PMP. The presentation will describe the experience of the engineering team in implementing the use of the software together with the benefits and limitations of the system. The overview will also include an explanation of using the Varian supplied HASP key and SmartConnect.

The second part of the presentation will explore the use of Redmine, a web-based database, for the recording and management of machine faults and routine maintenance. This will include system implementation, the different system users and a summary of the benefits the system has provided since implementation.

**Experience of completing of a Safety Assessment for Administration of Radioactive Substances**

Susan Manoy, Kate de Burgh

On 1st October 2023 the HSE changed the way in which employers can apply for Consent under IRR17. The process now involves the completion of a Safety Assessment for each consented activity. At the Royal Devon University Healthcare NHS Foundation Trust, we provide physics support and RPA services to the University of Exeter for their PET/CT scanner. The HSE contacted the University to request a Safety Assessment for the Administration of Radioactive Substances in January 2024, with submission required within 3 months.

The majority of the data within the Safety Assessment should come from the Radiation Risk Assessments. However, the process of completing the assessment highlighted some queries, including what is deemed to be an Engineering control as opposed to a System of Work, and whether a critical examination is required for shielding installations which aren't linked to a piece of radiological equipment.

The presentation will share our experience of the process, what we learnt along the way, and hopefully, if the HSE response to the Safety Assessment has been received in time, some learning from the HSE's feedback.