Researchfish Award Download for

PB-PG-0816-20027

PHOENIX-Feasibility: Picking up Hidden Osteoporosis Effectively during Normal CT Imaging without additional X-rays (Short Title: PHOENIX-F)

Dr Ken Poole

Award Title	PHOENIX-Feasibility: Picking up Hidden Osteoporosis Effectively during Normal CT Imaging without additional X-rays (Short Title: PHOENIX-F)
Award Reference	PB-PG-0816-20027
Research Organisation	Cambridge University Hospitals NHS Foundation Trust
Funding Start Date	2018-09-01
Funding End Date	2024-11-30
Funding Value	277430 GBP
Award Categories	City, Old SHA, Coordinating_Centre, ISRCTN Number, Award Type, Deanery, Mandatory, NIHR Reference, Type of Contact, Programme Stream ID, Postcode, LETB
Award Abstract	Following NHS screening committee advice, Shepstone and colleagues recently completed the SCOOP study, a five-year pragmatic trial of primary osteoporosis screening which reported that women ≥75 years who underwent screening had 28% fewer hip fractures than those receiving usual care3. We now wish to screen people attending radiology departments for diagnostic computed tomography (CT) scans, because >30% have undiagnosed vertebral fractures or osteoporosis. To identify osteoporosis opportunistically, we developed PHOENIX as an innovative 'one-stop' screening pathway. PHOENIX uses the same fracture risk assessment questionnaire (FRAX) as Shepstone, but here it is given to patients in the CT waiting room. We then retrieve CT images digitally, measure bone density, assess for vertebral fractures and provide a tailored bone health advice summary. PHOENIX software works on the CT scan images already performed for other reasons. Aims PHOENIX-F is a randomised, pragmatic feasibility study to inform a future multi-centre randomised controlled trial (RCT) investigating whether detecting osteoporosis and vertebral fractures in patients undergoing routine CT scans will improve health by reducing the burden of fractures. The primary objective is to test the feasibility of recruitment and retention of patients across five linked hospitals. We are also testing the digital links between our Addenbrooke's hub and four nearby

spoke hospitals. By testing the PHOENIX pathway versus usual care, we will also derive sample size estimates to inform the definitive trial by examining the proportion of patients treated for poor bone health at twelve months in the two study arms. Scaling up to multiple UK PHOENIX hubs, the definitive trial will focus on the fracture rate and health-related costs of the PHOENIX pathway. PHOENIX pathway With usual care, the completed FRAX questionnaire is sent to the GP only. With PHOENIX, an Addenbrooke's analyst calculates the ten-year fracture risk (FRAX), retrieves CT scans by NHS Image-Exchange-Portal (IEP), identifies vertebral fractures, measures spine/hip density and creates a bone health report using a NICE-compliant pre-specified algorithm that matches our standard bone density reports. The report is sent to the patients' GP, who initiates therapy and/or gives lifestyle advice. Plan of Investigation The study population will consist of women and men aged ≥50 attending for CT, for any reason, where the spine and/or hips are visible. Block randomisation to PHOENIX-F versus usual care will be 1:1 by age and gender within centre. We will determine the number of eligible patients and the number actually recruited within a ten-month recruitment window. After twelve months of follow-up, we will calculate the proportion of PHOENIX pathway patients who are treated for poor bone health in each arm (in single blinded fashion), and determine participant retention. Finally, we will examine recruitment differences according to patient characteristics (e.g. age, gender and indication for scan) to plan the appropriate randomisation schedule in any future trial. Assuming 250 responders from 1250 invites (20%) the true response rate can be estimated with 2.2% precision, and we will have 80% power to detect differences of ≥7% in twelve-month overall retention rates. Recruitment rates of ≥13% and retention rates of ≥73% are stop/go criteria for a definitive trial. PHOENIX costs will be estimated from the viewpoint of the NHS and personal social services. Resources associated with PHOENIX and those that might change as a result of it will be monitored, and we will determine the completion rates of the EQ-5D-5L questionnaire at baseline, six and twelve months. Summary of potential benefits to patients and the NHS The UK's

coordinated medical digital imaging network seems ideally suited to this opportunistic screening technology. Targeted screening may improve clinical and economic value through early diagnosis, identifying incident fractures and future fracture prevention.

Lay Summary

Osteoporosis makes bones become porous so they break more easily. It particularly affects the spine and hips. While treatment of osteoporosis is now quite straightforward, detection is difficult. In the UK, osteoporosis causes 200,000 vertebral fractures yearly in women and men. Since vertebral fracture pain can feel like ordinary backache, patients are often left undiagnosed, so multiple fractures are common. A computerised tomography (CT) scan uses x-rays and a computer to create images of the inside of the body; two million are performed each year in the UK, often for abdominal or pelvic problems. Nearly a third of those scanned have osteoporosis or vertebral fractures without knowing it. The PHOENIX pathway uses CT images to identify osteoporosis enabling early treatment and potentially preventing future fractures. The new technology makes it simple to measure bone density quickly and identify vertebral fractures from CT images of a patient's torso or pelvis. Measurements of the spine and hips are performed on images acquired from any CT scanner. Patients who are already attending hospital for a CT scan will be invited to participate in this trial, regardless of the reason for their scan. One group of volunteers will be allocated to the PHOENIX pathway to diagnose osteoporosis and vertebral fractures from their CT images with an appropriate therapy recommendation. The other group will follow usual care where they are asked to complete an osteoporosis risk questionnaire that is then sent to their general practitioner. The study aims to discover whether the PHOENIX pathway will lead to better osteoporosis treatment rates and fewer painful fractures. This feasibility study will allow us to evidence patients' willingness to volunteer and consent to a year's follow-up. It will also test Addenbrooke's Hospitals' capability to connect to surrounding hospitals in a 'hub and spoke' model to provide the service.

Sections with Information

Publications

Bromiley PA, Clark EM, Poole KE. (2020). Computer-Aided Diagnostic Systems for Osteoporotic Vertebral Fracture Detection: Opportunities and Challenges. *Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research, 35*(12), pp. 2305-2306. doi: 10.1002/jbmr.4205

Chappell D, D'Amore S, Brown K, Gerety E, Poole K. (2020). Vertebral fracture and osteoporosis screening from routine CT as an added EXtra - the VORTEX study. *Bone Reports,* doi: 10.1016/j.bonr.2020.100540

Fleming J, Chappell DDG, Brown J, Clark EM, Shepstone L, Turmezei TD, ... Poole KES. (2023). USING STANDARD COMPUTERISED TOMOGRAPHY (CT) SCANS FOR OPPORTUNISTIC IDENTIFICATION OF OSTEOPOROSIS AND VERTEBRAL FRACTURES: VIEWS OF OLDER PATIENTS. Abstracts from the Osteoporosis 2023 Conference, Royal Osteoporosis Society, September 13–14, University of Manchester, UK.

Poole K, Chappell D, Brown J, Clark E, Fleming J, Shepstone L, ... Kaptoge S. (2022). OP0243 OSTEOPOROSIS CASE-FINDING IN PEOPLE UNDERGOING ROUTINE DIAGNOSTIC CT SCANS ALMOST TRIPLED THE RATE OF OSTEOPOROSIS TREATMENT AT 12 MONTHS. A RANDOMISED, MULTI-CENTRE FEASIBILITY STUDY USING WAITING ROOM FRAX, OPPORTUNISTIC CT BONE DENSITY AND VERTEBRAL FRACTURE ASSESSMENT VERSUS USUAL CARE. *Annals of the Rheumatic Diseases,* doi: 10.1136/annrheumdis-2022-eular.1747

Poole KES, Chappell DDG, Clark E, Fleming J, Shepstone L, Turmezei TD, ... Kaptoge SK. (2022). PHOENIX (Picking up Hidden Osteoporosis Effectively during Normal CT Imaging without additional X-rays): protocol for a randomised, multicentre feasibility study. *BMJ open, 12*(5), pp. e050343. doi: 10.1136/bmjopen-2021-050343

Awards and Recognition

Award Type	Personal invitation as keynote or other named speaker to a conference
Award Name	The John Addenbrooke's Lecture 2024
Individual	Ken Poole
Award Level	Regional (any country)
Year Awarded	2024
Award Description	The lecture, which was held at Astra Zeneca's imposing building on the Cambridge Biomedical Campus, was hailed a huge success by ACT's Director of Communications and Impact, Paul White: "We couldn't have been prouder of ACT and its impact following the John Addenbrooke's Lecture. For so many of our valued supporters to be there, listening to the extraordinary talks by some of the hospital's leaders in research and innovation, really showcased what our charity – and our supporters – can, and do, achieve across Addenbrooke's and the Rosie." He continued: "To hear three remarkable individuals, who between them are changing the way we treat life-limiting conditions such as osteoarthritis and inflammatory bowel disease, and driving forward innovation that will go on to save and change countless lives, talk of how grateful they are to ACT and its supporters, and how their work has only been possible because of the people in that room, was a moment to really be proud of – and one which will motivate us to do even more going forward."
Impact of Award	This was a chance to thank Addenbrooke's Charitable Trust, NHS Innovation award (which gave the seed funds for the eventual NIHR RfPB award) and give the brief, high-level results to the hospital supporters.
URL	https://act4addenbrookes.org.uk/john-addenbrooke-l ecture-inspires-and-drives-meaningful-changes-in-h ealthcare/
Digital ID	

Source	Manual
Publication ID	67d829aa8f4261.04744913

Award Type	Prestigious/honorary/advisory position to an external body
Award Name	NICE committee membership Diagnostic Advisory on Artificial Intelligence Technologies in Radiology
Individual	Daniel Chappell
Award Level	National (any country)
Year Awarded	2025
Award Description	Dan Chappell who led the PHOENIX-F study was, on the basis of the experience he gained with the PHOENIX study, recruited to Specialist Committee Member positions on the NICE Diagnostics Advisory Committee: Artificial intelligence technologies to aid the opportunistic detection of vertebral fragility fractures on radiographic images: Early Value Assessment (EVA) The Health Tech Programme at NICE focuses on the evaluation of medical and diagnostic technologies to help the NHS adopt clinically and cost-effective technologies. The programme also assesses the safety and efficacy of interventional procedures. NICE is committed to involving national organisations that represent patients or professionals in the assessment of technologies. For each assessment, the independent Diagnostics Advisory Committee comprises standing members and a number of additional Specialist Committee members with expertise relevant to the topic under evaluation. Expertise: The Health Tech Programme is recruited healthcare professionals, to join the Diagnostic Advisory Committee as Specialist Committee members for the topic outlined above, with expertise in the following areas: Consultant Radiologists Reporting and Diagnostic Radiographers Nurses Specialists (Osteoporosis, bone health) Consultant Orthopaedic Surgeon Consultant Geriatrician Physiotherapist GPs Pain specialists Rheumatologists Specialist Committee Members join the Diagnostics Advisory Committee for this topic and participate in the decision-making and recommendations on Artificial

	intelligence technologies to aid the opportunistic detection of vertebral fragility fractures on radiographic images. Candidates are expected to have a good knowledge of the issues in the clinical area, but not necessarily have experience using the specific technology. Applicants must be based in the UK. Specialist members of the Diagnostics Advisory Committee are integral to the Committee and it is important that they attend all meetings relating to the topic. Candidates should therefore provisionally reserve the following dates in their diaries at the time of application. If there are any changes to the dates below, you will be notified as soon as possible by the NICE team. During the scoping period, you may also be contacted by the NICE technical team with requests for clinical input to further develop our understanding of this topic. Scoping workshop 29th January 2025 at 9:30-13:30 Lead team meeting 2 May 2025 in the afternoon (time expectation 1.5 hours / exact time TBC) Diagnostics Advisory Committee meeting 13 May 2025 (time expectation 3.5 hours / exact time TBC closer to the date) Specialist member applicants will automatically be registered as stakeholders for this topic, upon completion of a stakeholder registration form and the CAU. Brian Shine Chair, Diagnostics Advisory Committee
Impact of Award	Dan Chappell and Ken Poole were the key experts for the NIHR ADOPT study https://www.ndorms.ox.ac.uk/research/adopt To describe the performance of the AI-enabled vertebral fracture identification platform compared with NHS radiology reports and local readers. With the PHOENIX-F RFPB award and ADOPT, Addenbrooke's Hospital is now the go-to centre for evaluating and adopting new technology to the NHS. The systems in place are fully-embedded in clinical practice beyond the duration of the award, and have been extended into the East of England to centres of greater societal need which currently lack then same technical expertise, Bedford, Huntingdon and Peterborough.
URL	https://www.nice.org.uk/guidance/indevelopment/gid - hte10059
Digital ID	

Source	Manual
Publication ID	67d8252d8ee1b1.45641686

Award Type	Research prize
Award Name	2024 Cambridge University Hospital Awards
Individual	Daniel Chappell
Award Level	Regional (any country)
Year Awarded	2024
Award Description	Runner up finalist Daniel Chappell, clinical projects manager Dan is known for identifying and treating patients with vertebral fractures. Spine fractures often go unnoticed in CT scans, but CUH has the highest identification rate in the country. Dan has taken a methodical approach to finding the fractures from among 40,000 CT scans done annually. And the team can measure a patient's bone density from the diagnostic CT scan already done, sparing the patient further scans. Sawston, Royal Papworth and other local hospitals also now benefit from Dan's techniques.
Impact of Award	Dan's career as an innovative NMAHP has grown and he is now a recognised leader as a result of this RfPB award. His work is part of the NIHR Cambridge 'Cambridge to Coast' initiative to move innovative diagnostics to those centres where there is a high burden of disease but less research and technical infrastructure. As an example, the Image Exchange Portal allows him to help patient care with remote diagnostics on scanners that have been calibrated in Bedford, Huntingdon and Peterborough.
URL	https://www.cambridgeindependent.co.uk/news/winner s-of-the-2024-cambridge-university-hospitals-award s-re-9394706/
Digital ID	
Source	Manual

Publication ID 67d826c68db543.76370096

Use of Facilities and Resources

Facility or Work Name	SECTRA National Image Exchange Portal
Facility Name	Sectra Limited
Provided Service/Resource	National exchange of CT images allowing seamless safe transfer of identifiable patient data among multiple NHS Hospitals
Subsequent Impacts	PHOENIX is the first study to use the Sectra Image Exchange Portal (IEP) technology to permit us to recruit and serve research volunteers among underserved populations. Sectra allowed us to recruit patient volunteers in Peterborough, Bury St Edmunds, Huntingdon, Bedford who would not normally be able to access either a) imaging research studies or b) state-of-the-art QCT diagnostic techniques. The NHS Sectra IEP is a 'sleeping giant' in terms of a shared research resource for pragmatic trials to improve patient care in the UK. Due to the NHS being a single provider, Sectra is especially suited to enhancing UK studies.
URL	https://medical.sectra.com/product/sectra-image-ex change-portal/
Digital ID	
Source	Manual
Publication ID	67fe4abd518759.37115993

CCF Programmes-Publications

Publication potential.	Adoption into the health service beyond the location of the research

Influence on Policy, Practice, Patients and the Public

Influence Name	Through our work on PHOENIX, we became the first UK centre to deliver an accredited (UKAS) CT bone density diagnostic service in routine clinical practice
Influence Type	Contribution to new or improved professional practice
Healthcare Area	
Title	
Issuing Organisation	
Publication citing your work	
Contribution description	From the Cambridge University Hospitals NHS Foundation Trust Linkedin page: We are currently the only site in the UK to have Quantitative CT (QCT) to be UKAS accredited! https://www.ukas.com/download-schedule/7002/DiagnosticImaging/ QCT allows us to reuse CT scans to measure the bone density of patients without the need for a DEXA scan. This means we can diagnose patients with osteoporosis sooner and get them on treatment sooner as well. With help from radiology, we offer QCT to screen patients in CT for osteoporosis before they have a fracture. Colleagues in rheumatology also use QCT to diagnose and monitor complex bone disease with confidence. Huge congratulations to everyone involved!
Cited Publication	
Year First Realised	2025
Geographic Influence	National
Country	United Kingdom
Area of policy influence.	Digital/Communication/Information Technologies (including Software),Healthcare
Describe Other	
Specific Impacts	Changes in efficiency and effectiveness of public service delivery

Impact Description	From Daniel Chappell Clinical Projects Manager @ Cambridge University Hospitals NHSFT | MPhil in Medical Science It has been many long years but we have finally managed to get this diagnostic service over the line. By reusing existing CT scans to diagnose #Osteoporosis we can not only save the NHS time and money, we can also save vulnerable patients the trip to CUH for a DEXA. We have helped thousands of patients with this service and we are only getting started at #CUH
URL	https://www.linkedin.com/posts/cambridge-universit y-hospitals_activity-7311114654036996096-p5QZ
Digital ID	
Source	Manual
Publication ID	67fe40290fb740.38146721

Patient and Public Involvement

Patient and public involvement	Yes
Why was PPI not applicable in your research?	
The way of patient and public involvement	Prioritising the research question(s),Design of the research,Management of the research,Undertaking the research
Give details of involvement of patients	
Give details of why not applicable	
Factors of success of patient involvement	Involving people throughout the research cycle,Effective building of relationships and trust,Close and effective collaborative ways of working,Building on existing relationships,Enthusiasm and commitment of all involved
Other factors to successful involvement	
Challenges of involvement	No challenges,Other
Why was involving people challenging?	Death/Emigration of PPI representatives, due to nature of illnesses. Replaced with new PPI representatives.
Difference made by patient involvement	Our PPI panellists have improved the design of the study overall.

Medical Products, Interventions and Clinical Trials

Product Name	QCT (Quantitative Computed Tomography) to diagnose osteoporosis
Product Type	Diagnostic Tool - Imaging
Development Stage	Wide-scale adoption
Clinically Trialled	Not Applicable
CT name	
CT url	
participants number	
total participants	
ISRCTN ID	
ClinicalTrials.gov ID	
EUDRACT ID	
Clinical Trial Phase	
Other ID	
Year Stage Completed	2019
Development Status	Under active development/distribution
Product Description	First UK accredited QCT diagnostic imaging service :https://www.linkedin.com/posts/cambridge-universi ty-hospitals_activity-7311114654036996096-p5QZ Dual Use: Analysis of Existing CT Scans Mindways CliniQCT supports analysis of qualifying CT scans acquired for another reason. Because a phantom does not have to be imaged with the patient, the only requirements for analysis are that the scan covers an appropriate anatomical region and is free of contraindications*. This capability provides valuable information for clinicians and researchers alike, while applying no additional radiation dose to the patient. Clinical In the United States, 245 CT scans are performed per 1000 people per year. What if patients

prescribed a CT scan for another reason could simultaneously receive a bone density screening with no additional radiation dose? With CliniQCT, this is possible. If you already have or you plan to acquire CT images of your cohort, you can measure bone density from qualifying scans. Grant money is tight and patient time limited, so dispense with additional scanning and use CliniQCT. *IV contrast agent is contraindicated for use with CliniQCT. **OECD https://data.oecd.org/healthcare/computed-tomograp hy-ct-exams.htm CliniQCT CliniQCT represents the foundation of Mindways QCT product offerings. Intended for routine clinical screening, CliniQCT is designed for workflow efficiency and ease of use. CliniQCT is the ideal system for clinical sites performing standard bone density screening. Analyze both the spine and hip in one quick exam* without the presence of a calibration phantom underneath the patient. Process The process is simple: perform a standard abdomen/pelvis CT scan capturing the lumbar spine and hip, send the image series to CliniQCT via the integrated DICOM server, perform a 2-3 minute analysis in the CTXA Hip and Volumetric Spine modules, and then print the report or send it to PACS with the standard PACS export module. Time Total time including both scanning and analysis is typically ten to fifteen minutes, and CliniQCT can be installed on an existing PC in the CT control room, minimizing additional space requirements and costs.

Achievements

First product/intervention of its class,Reinforced existing standards of care,Improved delivery of clinical service (increased capacity / patient through put) - timely access to service,Improved diagnosis

Impact Description

The Mindways QCT bone density diagnostic technique was incorporated into the FRAX tool (43,015,401 assessments have been done since FRAX was launched in 2011). As you can see from the 43 million calculations, FRAX is the gold standard for fracture risk and intervention thresholds in 67 countries worldwide, so getting opportunistic QCT technology incorporated into FRAX was a major step. https://www.fraxplus.org/calculation-tool/

URL	https://www.qct.com/FAQ.html
Digital ID	
Source	Manual
Clinical Trial Registry Source	
Publication ID	67fe46c8c2e513.72301154

Engagement Activities

Activity Title	Launch of Royal Osteoporosis Society Research Road Map
Activity Type	A formal working group, expert panel or dialogue
How many people?	51 - 100
Geographical Reach	National
Primary Audience	Patients, carers and/or patient groups
Other Audience	Policymakers/politicians,Professional Practitioners,Supporters,Patients, carers and/or patient groups
Activity Years	2021
Result Description	The Research Roadmap, developed by the Osteoporosis & Bone Research Academy, sets out research priorities for the next three to five years. This was launched to leading experts in the field of osteoporosis and bone health on 1 December 2020 at the digital learning event Osteoporosis Online. It will be published in January 2021. The roadmap presents state of the art scientific projects which will improve bone health across life, and research to better understand the genetics, mechanisms and risk factors behind the disease. It also examines how new and novel technologies will help to advance diagnosis, detection and assessment of bone health, and approaches to improve the effectiveness of existing and developing treatments, to ensure that those living with osteoporosis receive the best care and enjoy the best quality of life. The roadmap will: • Be used by patients to see our progress working towards a cure for osteoporosis • Help raise public awareness of osteoporosis and the need for everyone to take bone health seriously • Attract fundraising to support our research over the next three to five years
Most important impact?	Plans made for future related activity
URL	https://theros.org.uk/osteoporosis-research/resear ch-roadmap/roadmap-to-a-cure/

Digital ID	
Source	Manual
Publication ID	60229f54b4f039.57825992

Activity Title	Review relevant to PHOENIX (in press) of CT Diagnosing Osteoporosis, Vertebral Fractures and Low Bone Strength from CT Scans: a rapid evidence review
Activity Type	A magazine or newsletter (print or online)
How many people?	51 - 100
Geographical Reach	National
Primary Audience	Professional Practitioners
Other Audience	Professional Practitioners,Undergraduate students,Postgraduate students
Activity Years	2019
Result Description	First commissioned work is a Review for the CCF program relevant to PHOENIX (in press) of CT Diagnosing Osteoporosis, Vertebral Fractures and Low Bone Strength from CT Scans: a rapid evidence review. Final author Poole
Most important impact?	Plans made for future related activity
URL	
Digital ID	
Source	Manual
Publication ID	6022a469127ef0.34161608

Activity Title	Royal Osteoporosis Society
Activity Type	A formal working group, expert panel or dialogue
How many people?	More than 500
Geographical Reach	International

Primary Audience	Media (as a channel to wider audiences)
Other Audience	Media (as a channel to the public),Policymakers/politicians,Professional Practitioners,Public/other audiences,Industry/Business,Supporters,Third sector organisations
Activity Years	2019
Result Description	Launch of the Royal Osteoporosis Society. Dr Ken Poole asked to chair the Technology Working Group which coincided with the launch, extensive coverage in the news media and on line.
Most important impact?	Plans made for future related activity
URL	https://www.med.cam.ac.uk
Digital ID	
Source	Manual
Publication ID	5c7e96507cbaf7.41066549

Next Destination

Label	Karen Blesic
Previous Role	Researcher (No PhD)
Has moved role	Yes
Organisation Known	Yes
Organisation Name	Cambridge University Hospitals NHS Foundation Trust
New Sector	
Destination Country	
Digital ID	
Source	RF
Publication ID	5c7e957a62c740.62213071

Label	Karen Willoughby
Previous Role	Research Project Leader
Has moved role	Yes
Organisation Known	Yes
Organisation Name	University of Cambridge
New Sector	
Industry sector/discipline the staff member moved to.	
Destination Country	
Digital ID	10. https://uk.linkedin.com/in/karen-willoughby-737a57 32
Source	RF
Publication ID	67fe33846cc6e4.19722863

NIHR Data sharing

Data share request	No
Data shared with others	No
Who were the data shared with	
Other	
Other	
Purpose of sharing	
Mechanism and process used	
Please provide a DOI for the associated data set	
Who have you shared data with?	
Sharing agreement	
DOI - related	
If "No" or "Not applicable", please explain why.	Still collecting data as part of the extension to study
Sharing agreement	No
If "No" or "Not applicable", please explain why.	We have not finished the study and locked the data set yet.

Software and Technical Products

Select type of technical product.	Webtool/Application
Short title or name for the product.	QCT software to diagnose osteoporosis from CT scans, and incorporation into webtool (FRAX online patient fracture calculator)
Licenced	No
Open Source license	
Briefly descrive technical product.	*Diagnostic software* An improved sofware tool was developed to diagnose osteoporosis in the clinic: QCT Pro devices >500 have been used worldwide. Cambridge University research was critical for the approval of the QCT Pro method to diagnose osteoporosis in routine clinical practice , via the International Society of Clinical Densitometry (ISCD) official position statement which cited five papers from the University of Cambridge. *Webtool and online FRAX fracture risk calculator* A further health impact of improved diagnosis occurred as QCT Pro measurements of bone density were then incorporated into FRAX, the online fracture risk prediction tool and App. Developed by Sheffield University, FRAX evaluation of fracture risk was restricted to clinical risk factors and hip bone density values alone hip (from Dual-energy X-ray Absorptiometry, DXA). With the introduction of QCT Pro, FRAX now has the facility, in 66 countries worldwide, to calculate patient risk estimates from QCT Pro measurements of bone density as well as DXA . Dr Brown, President of Mindways QCT Pro commented, “Ken, your work demonstrating superiority of QCT-based hip measurements to DXA-based hip measurements for assessment of hip fracture risk assessment has been pivotal in obtaining recognition within ISCD position statements of the clinical utility of QCT-based assessments of the hip in predicting hip fracture risk.” * Poole KES, Skingle L, Gee AH, Turmezei TD, Johannesdottir F, Blesic K.. Reeve, J, Treece GM. Focal osteoporosis defects play a key role in hip fracture. Bone.

	2017;94:124-34 *. * Treece GM, Gee AH, Tonkin C, Ewing SK, Cawthon PM, Black DM, et al. Predicting Hip Fracture Type With Cortical Bone Mapping (CBM) in the Osteoporotic Fractures in Men (MrOS) Study. Journal of Bone and Mineral Research. 2015;30(11):2067-77 *. * Johannesdottir F, Poole KES, Reeve J, Siggeirsdottir K, Aspelund T, Mogensen B, et al. Distribution of cortical bone in the femoral neck and hip fracture: A prospective case-control analysis of 143 incident hip fractures; the AGES-REYKJAVIK Study. Bone. 2011;48(6):1268-76 *. ortical Bone Mapping: Measurement and Statistical Analysis of Localised Skeletal Changes Gregson CL, Armstrong DJ, Bowden J, Cooper C, Edwards J, Gittoes NJL, Harvey N, Kanis J, Leyland S, Low R, McCloskey E, Moss K, Parker J, Paskins Z, Poole K, Reid DM, Stone M, Thomson J, Vine N, Compston J. UK clinical guideline for the prevention and treatment of osteoporosis. Arch Osteoporos. 2022 Apr 5;17(1):58. doi: 10.1007/s11657-022-01061-5. Erratum in: Arch Osteoporos. 2022 May 19;17(1):80. doi: 10.1007/s11657-022-01115-8. PMID: 35378630; PMCID: PMC8979902.
Select the year that this output was realised.	2022
Briefly describe notable impacts.	*PHOENIX and QCT* Developing novel imaging approaches to diagnose osteoporosis on routine CT scans: Osteoporosis is usually not detected until patients present with painful fractures. Earlier detection in the PHOENIX study offers the opportunity for intervention, treating patients before fractures develop or progress. Cambridge imaging research was critical in testing, validating and implementing Quantitative Computed Tomography (QCT), a method to diagnose osteoporosis in routine clinical practice, and used in the PHOENIX clinical research study. QCT measures bone mineral density (BMD) using a standard CT scanner that can convert the tomographic image data to BMD values. QCT (also called Mindways QCT Pro) is used primarily to evaluate BMD at the lumbar spine and hip and to guide treatment decisions. In 2015, Ken Poole working with University of Cambridge Dept of Engineering researchers analysed a series of clinical trials involving 10 sites and 1,201 patients sampled from 11,178 volunteers. Together with

	Mindways software professionals and academic trialists in the USA, Iceland and Czech Republic, they showed that QCT-BMD measurement accurately predicts hip fractures in healthy women and men . *Impact on practitioners and the delivery of professional services* Improved care of osteoporosis patients in the Cambridgeshire regional referral centre: In 2016 with the support of an NHS Innovation Award, Ken Poole and NIHR-supported colleagues established the QCT Pro Opportunistic Osteoporosis Screening Service at Cambridge University Hospitals. This service, endorsed by the Clinical Director of Radiology .
URL.	https://fraxplus.org/calculation-tool
URL.	https://www.qct.com/ExistingCTScans.html
Digital ID	10.1007/s11657-022-01115-8.
Source	Manual
Publication ID	67fe2fb994aba7.39304843

Further Funding

Funding Scheme	Circulating angiogenesis markers to predict incident osteonecrosis of bone
Organisation Name	Addenbrooke's Charitable Trust (ACT)
Type	Research grant (including intramural programme)
Funding Currency	GBP British Pound Sterling
Funding Amount	25458
Consortium Funding Amount	
Reference Number	
Start Month	October
Start Year	2019
End Month	May
End Year	2020
Project URL	
Digital ID	
Source	RF
Source ID	
Original Source ID	
Publication ID	6035471fc344d5.22013882

Funding Scheme	MRC-BBSRC Biomedical Industry Engagement Award
Organisation Name	University of Cambridge
Type	Fellowship
Funding Currency	GBP British Pound Sterling
Funding Amount	15254

Consortium Funding Amount	
Reference Number	RG97256
Start Month	November
Start Year	2018
End Month	February
End Year	2019
Project URL	
Digital ID	
Source	RF
Source ID	
Original Source ID	
Publication ID	603546be81f463.43616406

Funding Scheme	The role of osteocytes in modelling based bone formation on trabecular bone surfaces
Organisation Name	Addenbrooke's Charitable Trust (ACT)
Type	Research grant (including intramural programme)
Funding Currency	GBP British Pound Sterling
Funding Amount	10000
Consortium Funding Amount	
Reference Number	RG96705
Start Month	May
Start Year	2018
End Month	May
End Year	2020
Project URL	

Digital ID	
Source	RF
Source ID	
Original Source ID	
Publication ID	6035462b456941.82046442

Collaborations and Partnerships

Collaboration Title	Collaboration NIHR Artificial Intelligence in Healthcare Grant, stage 2 in partnership with Zebra Medical, University of Oxford
Partner	
Organisation Name	University of Oxford
Contributed Financially	No
In-kind contribution	No
Organisation Name	zebra medical vision
Contributed Financially	No
In-kind contribution	No
Contributions Made	Partnership study design looking at opportunistic use of CT in osteoporosis diagnosis
Partner Contributions	Providing expertise and study resources
Year Commenced	2021
Year Ended	Still Active
URL	
Resultant Outcomes	Just commenced
Categorisation of impact	No impact yet
Formally Governed	No

Collaboration Title	University of Bristol
Partner	
Organisation Name	University of Bristol

Contributed Financially	Contractually Confidential
In-kind contribution	No
Contributions Made	Partnership in design of PHOENIX-f project with Dr Emma Clark
Partner Contributions	Partnership in design of PHOENIX-f project with Dr Emma Clark
Year Commenced	2018
Year Ended	Still Active
URL	http://www.med.cam.ac.uk/poole/phoenix/
Resultant Outcomes	In progress
Formally Governed	No

Collaboration Title	University of East Anglia
Partner	
Organisation Name	University of East Anglia
Contributed Financially	No
In-kind contribution	No
Contributions Made	Design of PHOENIX-f project with Prof Lee Shepstone and Health economics with Adam Wagner
Partner Contributions	Design of PHOENIX-f project with Prof Lee Shepstone and Health economics with Adam Wagner
Year Commenced	2018
Year Ended	Still Active
URL	http://www.med.cam.ac.uk/poole/phoenix/
Resultant Outcomes	In progress
Formally Governed	No