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DXA

(Dual-energy X-ray Absorptiometry Project)

HIP₁

(Health Informatics Prediction)

MAP₂

(Management Application Process)

Projects

Health Research Board Funded Projects:

1) SDAP_2021_001

2) SDAP_2023_010



University
ofGalway.ie

Global Burden of Disease (GBD)



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- A comprehensive picture of mortality and disability across countries.
- Quantifies health loss from diseases, injuries, and risk factors, so health systems can be improved and disparities eliminated.
- 281,586 data sources to estimate mortality, health outcomes, and risks in 2019;
- >3.5 billion standardized and comprehensive estimates of health outcome and health system measures;
- >350 health outcomes and risk factors;
- >10,000 individuals from >160 countries and territories collaborate.
- Funded by the Bill & Melinda Gates Foundation.

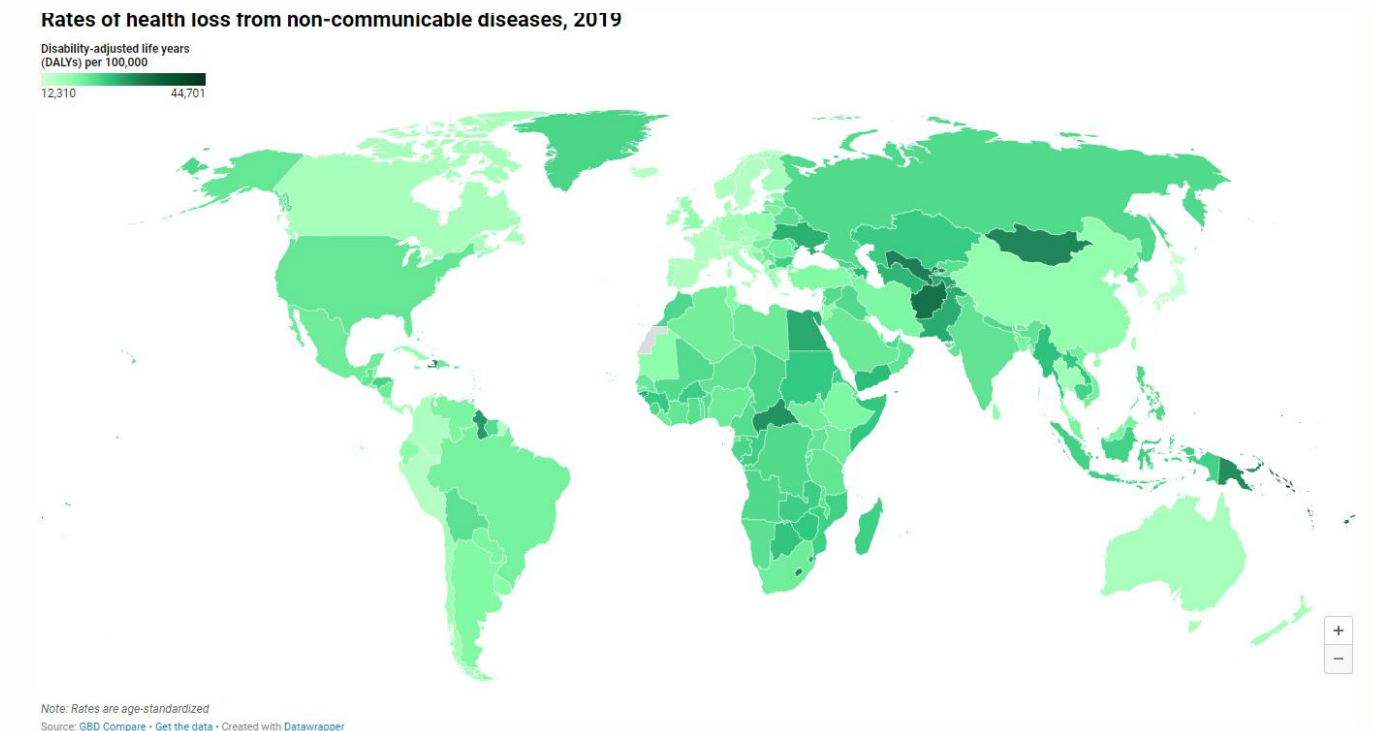
1. <https://www.healthdata.org/research-analysis/gbd>
2. GBD 2017: A Fragile World. The Lancet 2018; 382: 1683.

2017: Non-communicable Diseases (NCDs)



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- Global Adult Mortality rates plateaued in 2017!
- NCDs account for 73% of global deaths.
- >50% (29 million) are accounted for by 4 risk factors:
 - High body mass index (DXA-MAP)
 - High blood pressure (DXA-MAP)
 - High blood glucose (DXA-MAP)
 - Smoking (DXA-MAP)
- No country is on track to meet all the WHO's sustainable development goals by 2030



1. <https://www.healthdata.org/research-analysis/gbd>
2. GBD 2017: A Fragile World. The Lancet 2018; 382: 1683.

The Irish Times 16th May 2023



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Paul Cullen

- **2022** Government allocated €360M to cut waiting lists;
 - Target: 17% - Actual result: 1%
- **2023** Government allocated €443M;
 - Target: 10%, but already this number has increased from 870,000 in December 2022 to 888,000 in April 2023.
 - Cancellations in April 2023 up almost 70% from April 2022.
- ***“And we have no idea whether value for money is being achieved”!***

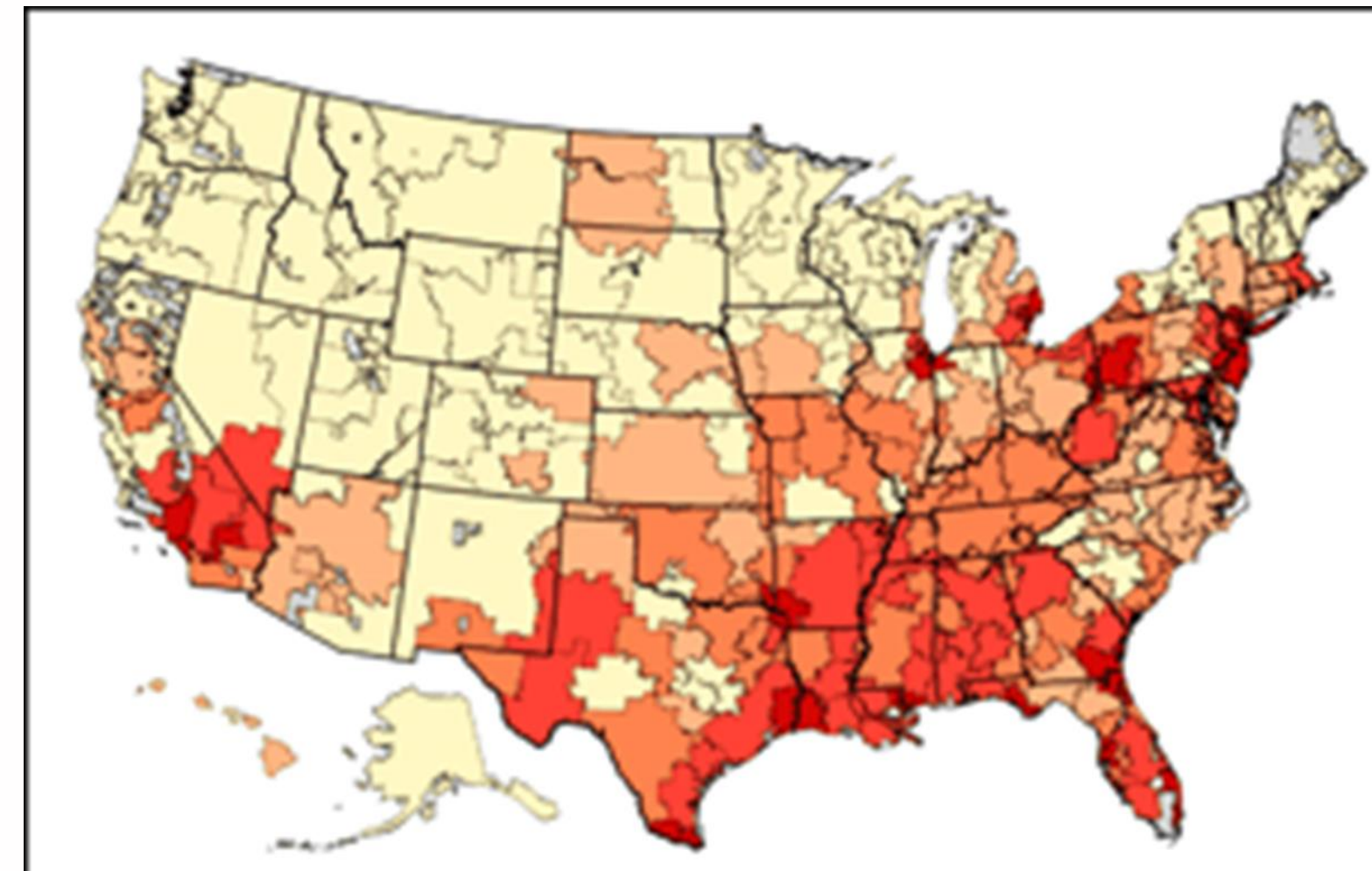
US Study: Is more Healthcare better?



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Fisher ES. Ann Intern Med 2003 138(4): 273-287 & 288 – 298.

- Compared Cost of care Vs Outcome for 3 NCDs:
 - Cardiovascular disease
 - Cancer
 - Osteoporosis (Hip Fracture).
- Higher spending regions: More Hospital-based care
- Outcomes in HSRs did NOT shows an increase in:
 - Quantity of life
 - Quality of life
 - Satisfaction with care.



Osteoporosis: A Consensus Definition




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“Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of future fracture.

Bone strength primarily reflects the integration of ***bone density and bone quality***.

Bone quality refers to architecture, turnover, damage accumulation and mineralisation.”

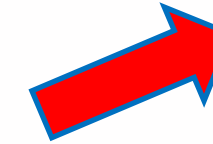
Global Burden of Osteoporosis

- **Osteoporosis is a complex chronic NCD.**¹
- **Most prevalent bone disease** worldwide, and among the most prevalent diseases.¹⁻⁴
- **Consequence:** skeletal failure.
- **Clinical events:** Fractures / Broken bones.
- **Test:** DXA scan, others.
- 2019 European report of 29 countries.¹
- **Fractures are a global public health issue.**²
- 204 countries : 1990 – 2019
- **2019:**
 - 178M new fractures
 - 455M prevalent cases (70%  since 1990)
 - 25.8M YLDs
- Age-specific incidence greatest among older people = **Osteoporosis**



Global Burden of Osteoporosis

➤ US Study of 83,724 multiethnic Postmp women 50-79 followed for mean 7.7years (NonVFX);¹



➤ **2019:** Europe (EU + UK + Switzerland)²

➤ Prevalence: >32 million adults;

➤ > 4 million fractures;



➤ > 250,000 Deaths;

➤ Direct Fracture Treatment costs: €60 Billion (€200)



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1) Cauley JA Osteoporos Int 2008; 19: 1717-23.

2) Kanis JA. Arch Osteoporos 2021; 16:82.

Annual Incidence (%) in W.H.I. Study

Cauley JA Osteoporos Int 2008;17:17-23.

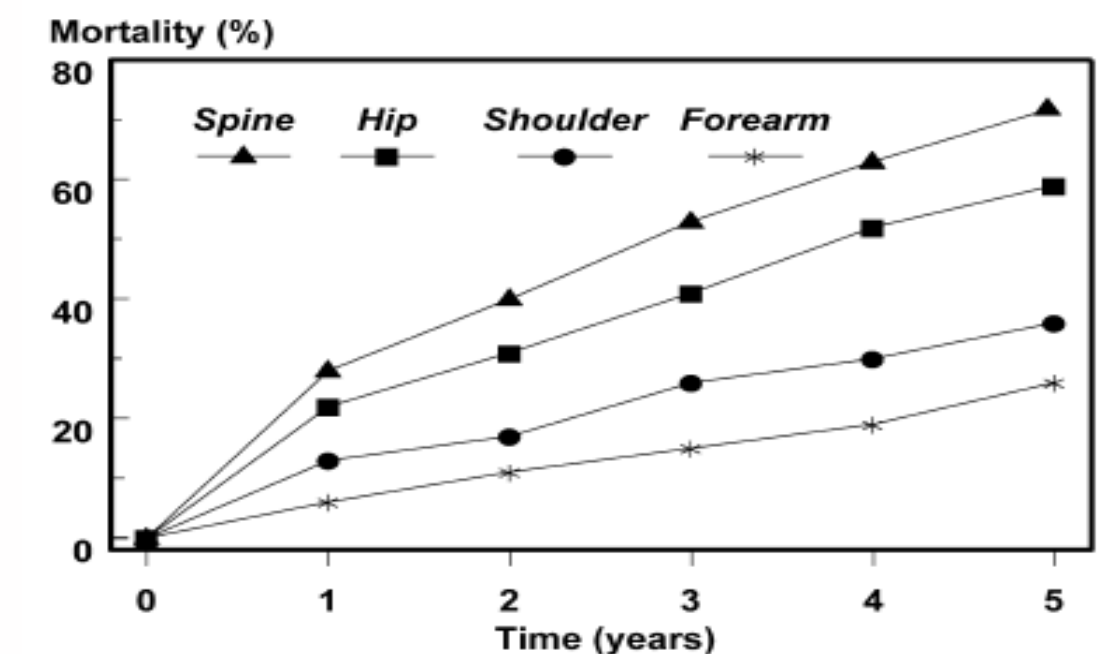
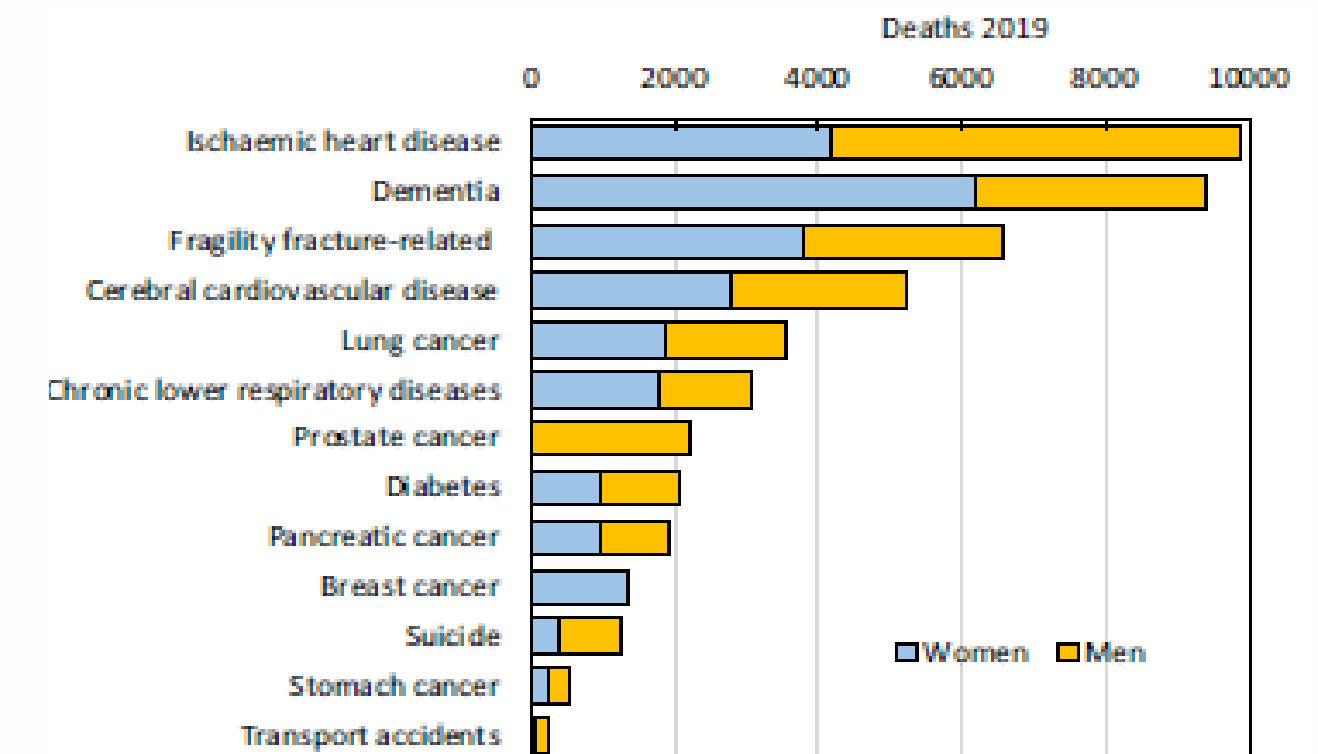
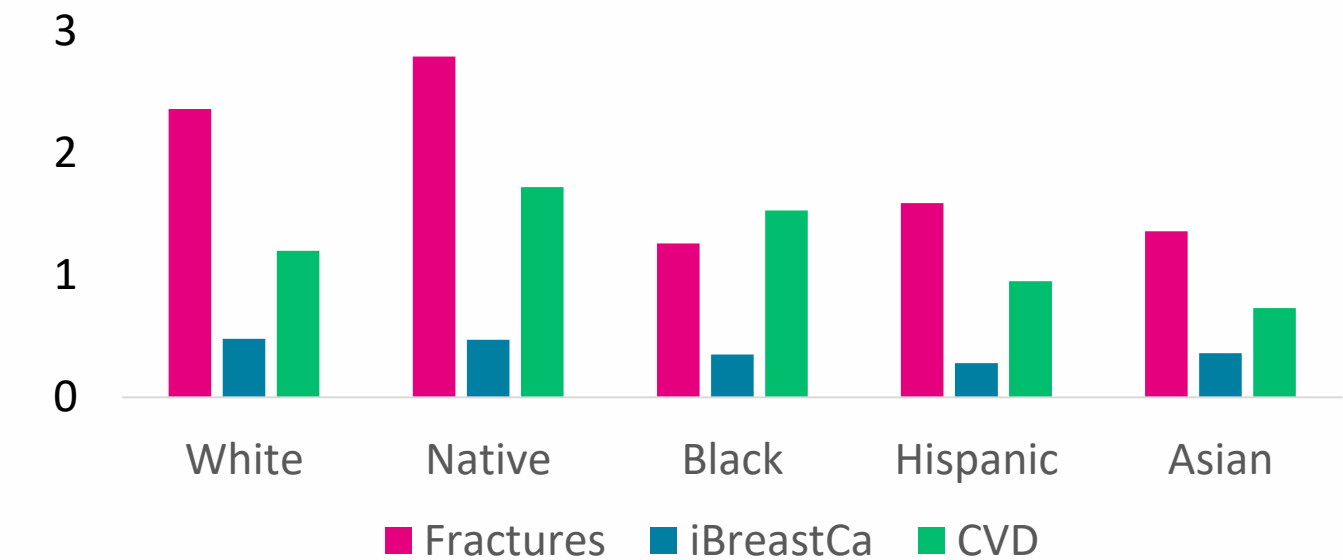


Fig. 1 Cumulative mortality following a fracture at the sites shown

Osteoporosis in 2024



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Clinical

Central DXA T-score ≤ -2.5

<https://iscd.org/official-positions-2023/>

Major Osteoporotic Fracture

Hip, Spine, Other?

Mayo Clin Proc 2024: 1127-41.

Gold Standard: T-L Bone Bx

Best Pract Res Clin Rheumatol 2022: 101775.

Public Health

“A Major Health Threat”

JAMA 2001: 785-95.

“Global Public Health Issue”

Lancet Healthy Longev 2021:e580-92.

“Major Public Health Concern”

Mayo Clin Proc 2024: 1127-41.

“A common disease that has a significant impact on patients, healthcare systems and society”

JBMR+ 2023: rkad091.

Patient

“Something that doesn’t just shatter your bones, but it also shatters lives”.

“A very painful condition”.

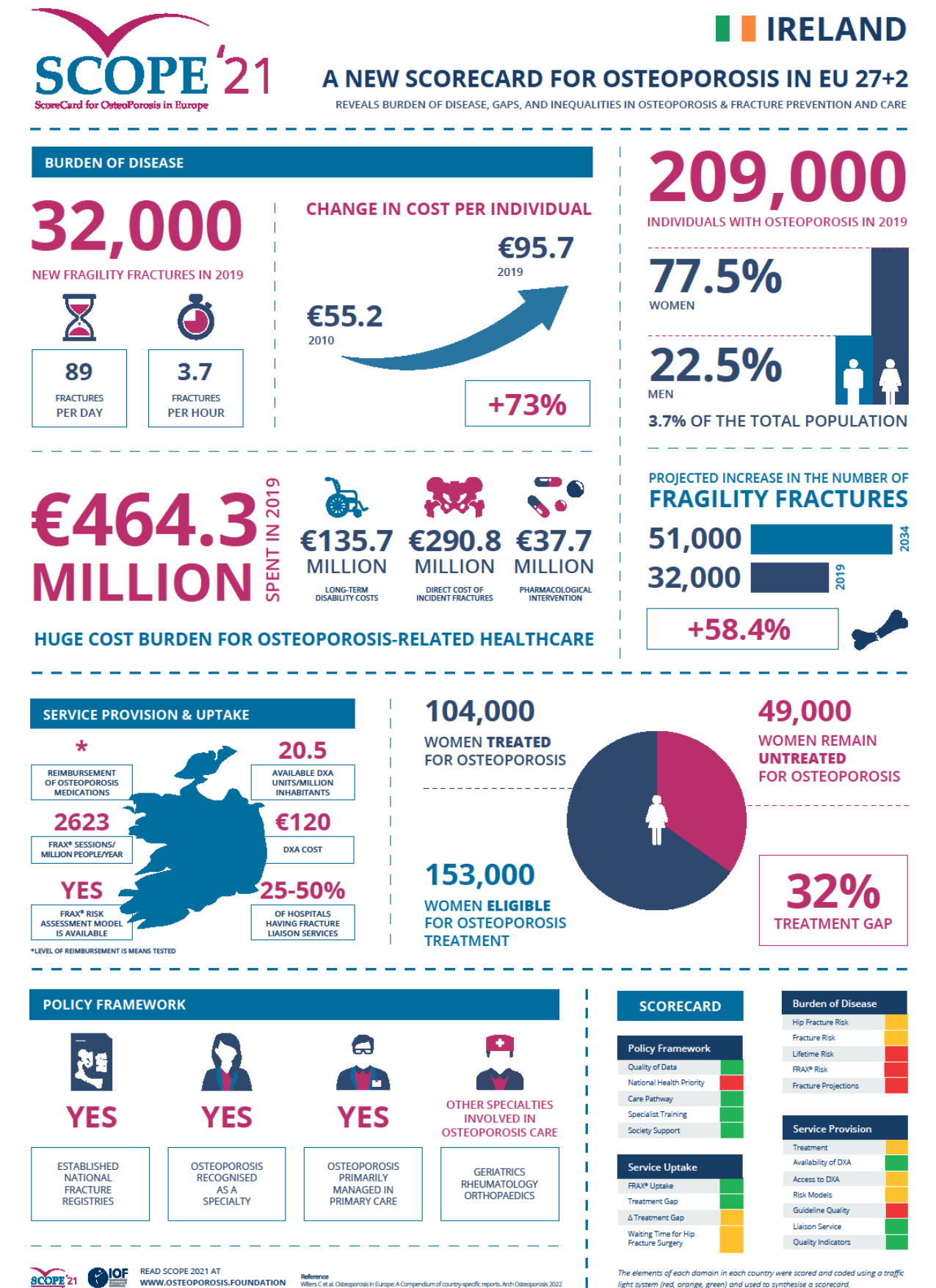
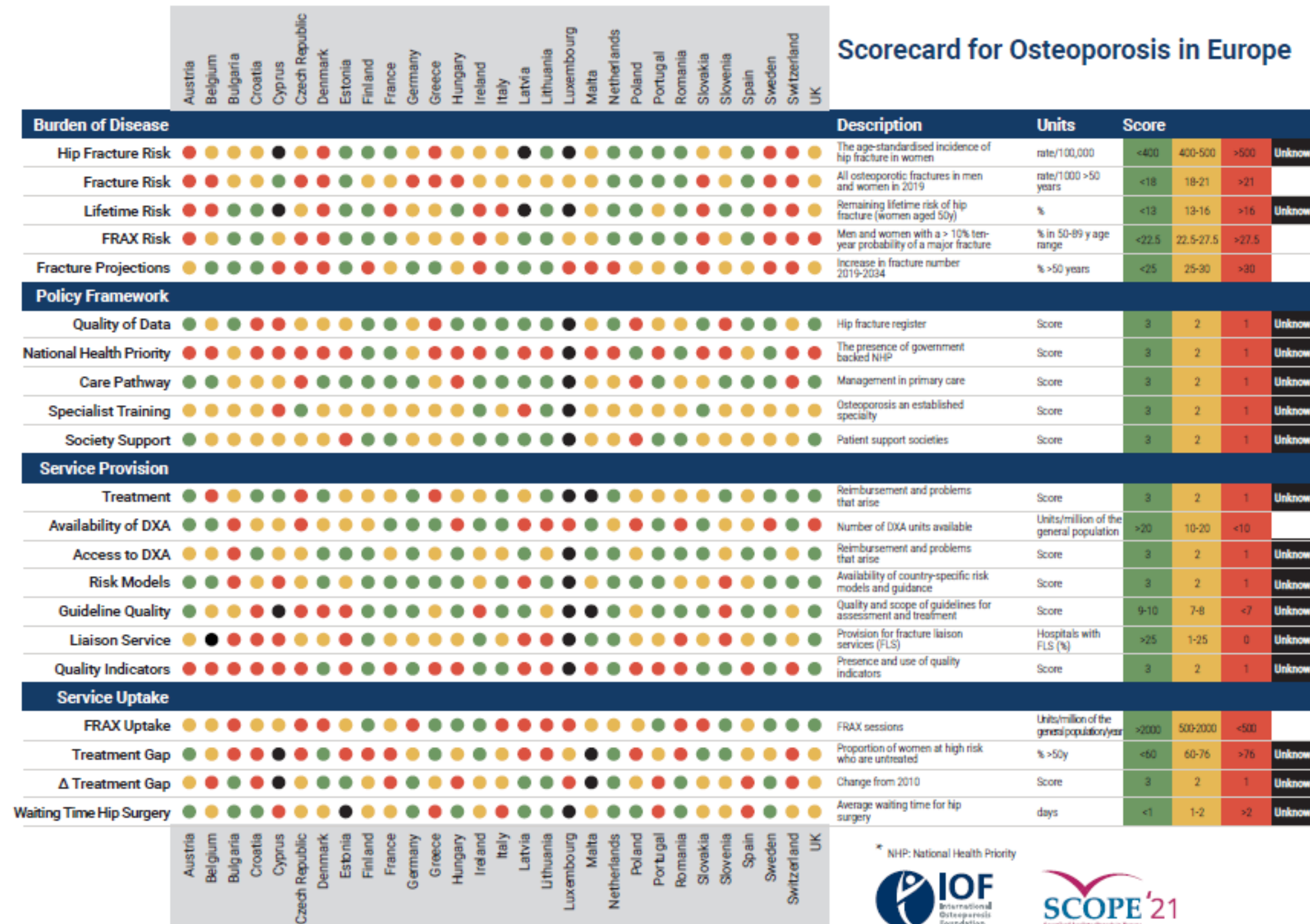
“A life-altering and very costly disease of the skeleton”.

What About Ireland?

Kanis JA. Arch Osteoporos 2021; 16:82.



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Principle Components of DXA Technology

Interpreter

Printer

Screen

Computer

Operator

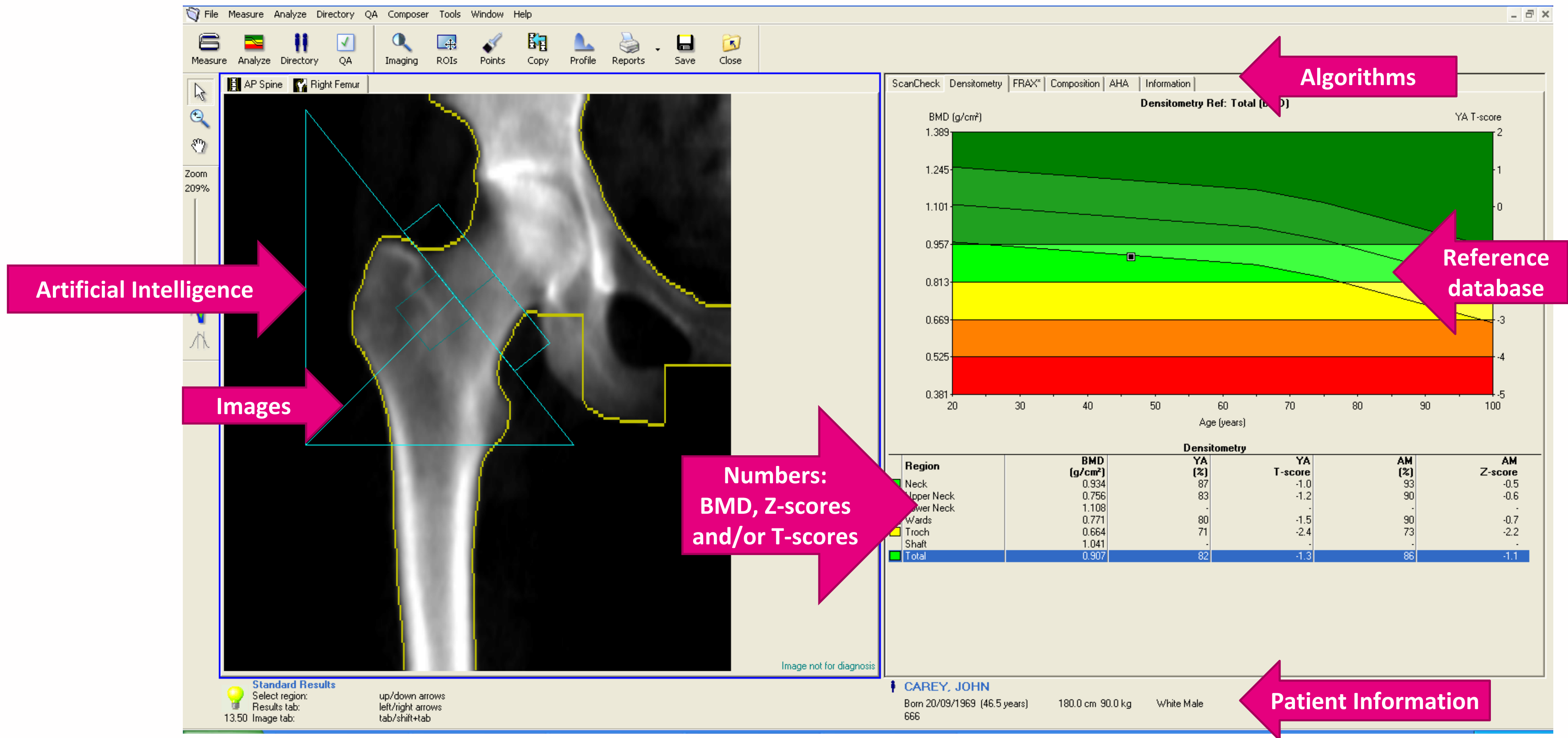
X-ray Source

Detector Arm

Patient

Table





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Ireland:

Almost 80 DXA machines performing 100,000 DXA scans annually

DXA HIP Objectives



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1. Data Management: Extraction, Merging, Cleaning, Anonymization.
2. Calibration of FRAX, Qfracture, Other currently used Algorithms.
3. Use data and ML to Identify optimal thresholds for Irish people.
4. Develop a Personalised Osteoporosis / Fracture Risk Model for Irish people.
5. Disseminate the Findings of the DXA HIP Project



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The DXA HIP/MAP Project Team

Researchers

Dr. Attracta Brennan
Ms. Mary Dempsey
Dr. Erjiang E
Dr. Tingyan Wang
Dr. Lan Yang
Professor Máire Connolly
Professor Mary Fitzgerald
Dr. Damian Gonzalez Garza
Dr. John Smyth
Ms. Mina Ibrahim Erjestan
Professor Ming Yu
Ms. Eléa Thuillier

Clinicians

Professor John J Carey
Professor Bryan Whelan
Dr. Carmel Silke
Dr. Miriam O Sullivan
Dr. Gráinne O'Malley
Dr. Guadalupe Morote Ibarrola
Ms. Bridie Rooney
Ms. Aoife McPartland
Ms. Catherine Armstrong
Ms. Fiona Heaney
Ms. Rebecca Egan
Ms. Kelly Gorham
Ms. Aoife Dempsey

Patients & Public

Mrs. Marie Caffrey
Mrs. Catherine Hickey-O'Maoláin

The Coffee Morning Crew

GUH staff and Patients

SUH and MH Staff and Patients

GPs in Galway and Sligo

Collaborators

Professor Wing Chan, Taiwan
Professor Manju Chandran, Singapore
Professor Andrea Singer, USA
Professor Joshua Lewis, Australia?

Output from DXA HIP and DXA MAP

1. **DXA dataset:** Demographics, biometrics, algorithms, outcomes.

2. **11 Publications:**

3. **Oral Presentations:** ISR, WCO; Posters: WCO, ECTS

4. **Workshops and PPI Engagement:** WOD, Workshops, Coffee Mornings, Other

5. **Health Policy:** Engagement, Booklet, Politicians, Media: >10million in 2024!

6. **DXA MAP Tool**



Publications



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1. **The Irish dual-energy X-ray absorptiometry (DXA) Health Informatics Prediction (HIP) for Osteoporosis Project.** PMID: 33371026.
2. **Conceptual design of the dual X-ray absorptiometry health informatics prediction system for osteoporosis care** PMID: 35257612
3. **Machine Learning Can Improve Clinical Detection of Low BMD: The DXA-HIP Study.** PMID: 33187864.
4. **Utility of Osteoporosis Self-Assessment Tool as a Screening Tool for Osteoporosis in Irish Men and Women: Results of the DXA-HIP Project** PMID: 33789806
5. **Vertebral Fractures in Ireland: A Sub-analysis of the DXA HIP Project** PMID: 34085087
6. **How does proximal femur BMD of healthy Irish adults compare to NHANES III? Results of the DXA-HIP Project** PMID: 34773128
7. **Ireland DXA-FRAX may differ significantly and substantially to Web-FRAX** PMID: 36939937
8. **Prevalence of Low Bone Mass and Osteoporosis in Ireland: the Dual-Energy X-Ray Absorptiometry (DXA) Health Informatics Prediction (HIP) Project** PMID: 37808396
9. **Bone mineral density and fractures in patients with rheumatoid arthritis: the DXA-HIP project** PMID: 38025094
10. **Modelling future bone mineral density: Simplicity or complexity?** PMID: 38972532
11. **DXA and Cardiovascular Disease in Rheumatoid Arthritis: A scoping review.** J Clin Densitom, 2025: In Press.

As a result we know



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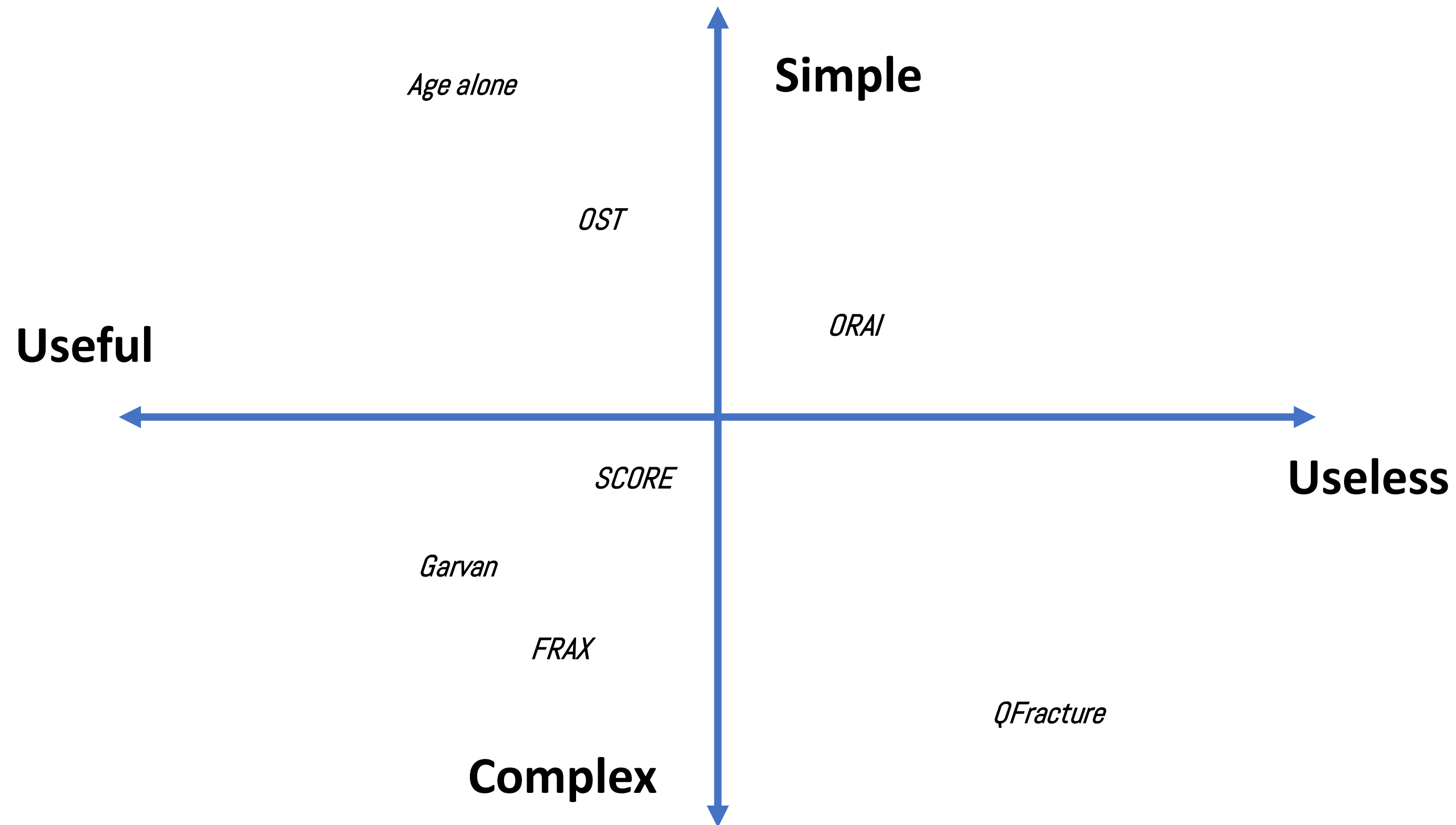
1. Between 300,000 and 500,000 Irish adults aged ≥ 50 years have osteoporosis;
2. Irish people who suffer an osteoporotic fracture have substantial morbidity and a high mortality too;
3. The majority of Irish patients with, or at risk for, a fracture are not receiving appropriate care, while others not at risk are.
4. We have validated some of the most commonly used osteoporosis clinical algorithms, and identified gaps in knowledge, their use and interpretation among clinicians and patients;
5. We have developed a more user-friendly algorithm to screen Irish adults;
6. We have initiated a policy document to gain traction for a national osteoporosis programme for how to evaluate, treat and manage those at risk based on standards and best practice.
7. This will improve the quality of care and “value for money”.

Current “Osteoporosis” Algorithms

Carey JJ, Brennan AB, in press



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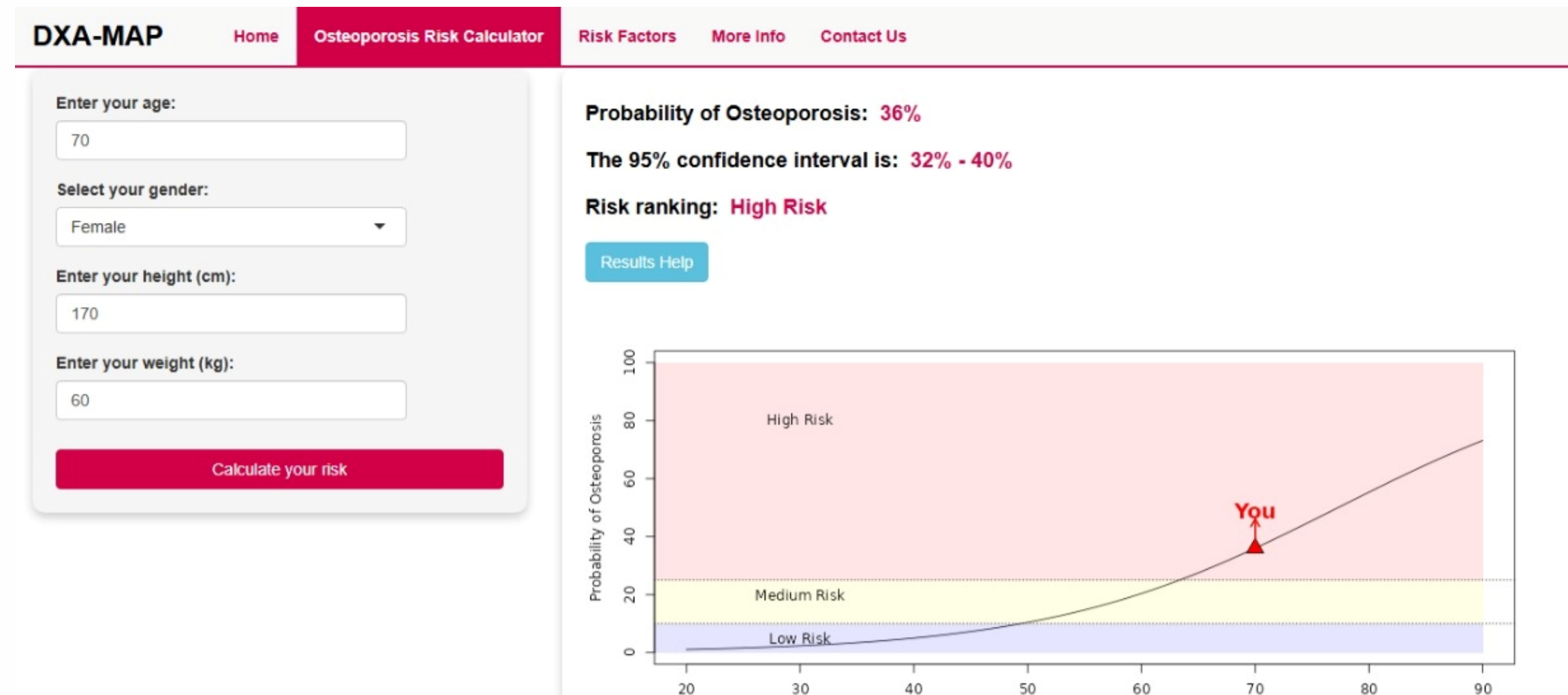


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DXA MAP Tool

**A Personalised
patient-centred tool for
osteoporosis screening**

University
ofGalway.ie





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A new Paradigm in Osteoporosis Screening

Carey JJ, Brennan AB, in press

1. Identify those who should be tested
2. Test the person
3. Use the test results to assess their risk and who should be treated

Opportunities and Challenges



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➤ Working for the HSE

- Access to Healthcare **data**
- Access to DXA **data**
- Support of patients & staff
- Lack of Robust Irish **Data**

➤ Working for University

- Access to Academics
- **Culture** of Learning & Research
- International Recognition
- Research Vs Audit

➤ H.R.B. Funding

- Staff / Equipment / Meetings
- Recognition / Support / Knowledge
- Feedback / Structure / Deadlines
- Workshops & Meetings

➤ HSE

- Lack of Expertise & Support
- Complex pathways to success
- Inefficiency

➤ University

- Not the HSE = Governance?
- Inefficiency
- Lack of structures / support

➤ Research in Irish Healthcare

- Lack of Umbrella Policy
- Waste
- Lack of Data value
- Lack of Awareness

➤ **Administrator Vs Researcher?**



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Go Raibh Míle Maith Agaibh

See <https://dxa-map.com>