

Supplementary Table 1. Patient characteristics at presentation.

Patient characteristics at presentation (n=120 presentations)		
Mean age, years (range)		83 (70-95)
	Male	82 (70-93)
	Female	84 (72-95)
Sex, n (%)	Male	49 (40.8)
	Female	71 (59.2)
Mean weight, kg (range)		65.6 (33.2-157)
	Male	75.4 (45.0-157.0)
	Female	59.0 (33.2-137.2)
Mean Body Mass Index, kg/m ² (range)		25.1 (13.5-55.9)
Smoking status, n (%)	Non-smoker	43 (35.8)
	Ex-smoker	34 (28.3)
	Current smoker	4 (3.3)
	Unknown	39 (32.5)
Current consumer of alcohol, n (%)	No	66 (55.0)
	Yes	21 (17.5)
	Unknown	33 (27.5)
Number of falls in the last year, n (%)	0	52 (43.4)
	1	42 (35.0)
	2	25 (20.8)
	3	1 (0.8)
Resident in nursing or care home, n (%)		6 (5.0)
Past Medical History, n (%)	Osteoporosis	11 (9.2)
	Diabetes	31 (25.8)
	Rheumatological disease	1 (0.8)
	Dementia	37 (30.8)
	Active cancer	16 (13.3)
	Asthma or chronic obstructive pulmonary disease	15 (12.5)
	Previous myocardial infarction, ischaemic heart disease, stroke or transient ischaemic attack.	43 (35.8)
	Chronic liver disease	0 (0)
	Chronic kidney disease (stage 4 or 5)	14 (11.6)
	Parkinson's disease	5 (4.2)
	Malabsorption	3 (2.5)
	Osteogenesis imperfecta	0 (0)
	Premature menopause	1 (0.8)
	Other endocrine disorder	2 (1.7)

Past history of fragility fracture*, n (%)	19 (15.8)
Hip/pelvis	12 (10)
Wrist	4 (3.3)
Vertebrae	3 (2.5)
Fragility fracture sustained due to current fall, n (%)	7 (5.8)
Vertebral	4 (3.3)
Wrist/radius	2 (1.6)
Pubic ramus	1 (0.8)
Morphological vertebral fracture**, n (%)	11 (9.2)
Documented parental history fragility fracture/osteoporosis, n (%)	0 (0)
Drug history at presentation, n (%)	
Vitamin D/Calcium replacement	42 (35.0)
Bone protection therapy	8 alendronate (6.7)
	1 raloxifene (0.8)
Anti-depressants	18 (15.0)
Anti-epileptics	5 (4.2)
Aromatase inhibitors	4 (3.3)
GnRH analogues	4 (3.3)
Oral glucocorticoids	5 (4.2)

*15 patients had a past history of 19 fractures in total. One patient had sustained both a hip and a vertebral fracture, one patient had sustained two hip fractures and one radial fracture, and one patient had sustained two hip fractures. The remaining 12 sustained one fracture each.

**As defined by Genant et al. (1993), with no previously documented history of vertebral fracture.

Supplementary Table 2. Outlier case details, during comparison of FRAX and QFracture for 10-year risk of major fracture.

Case	FRAX (%)	QFracture (%)	Sex	Risk factors considered by both FRAX and QFracture	Risk factors considered by QFracture but not FRAX
<i>QFracture > FRAX</i>					
20	15	44.2	F	Aged 76 years, BMI 22.0 kg/m ²	Falls, ischaemic heart disease, Parkinson's disease, sertraline
106	12	46.8	M	Aged 89 years, BMI 27.2 kg/m ²	Falls, dementia, type 2 diabetes, TIA, falls, chronic kidney disease stage 4
110	19	58.1	F	Aged 90 years, BMI 30.1 kg/m ²	Falls, dementia, chronic obstructive pulmonary disease, care home resident, sertraline
118	23	52.3	F	Aged 85 years, BMI 22.0 kg/m ² , fracture	Falls, dementia, sertraline
<i>FRAX > QFracture</i>					
51	32	16.6	F	Aged 78 years, BMI 24.5 kg/m ² , fracture, alcohol >3 units/day	Alcohol 3-6 units/day

Supplementary Table 3. Outlier case details, during comparison of FRAX and Garvan for 10-year risk of major fracture.

Case	FRAX (%)	Garvan (%)	Sex	Risk factors considered by both FRAX and Garvan	Risk factors considered by Garvan but not FRAX	Risk factors considered by FRAX but not Garvan
<i>FRAX > Garvan</i>						
60	36	20	F	Aged 76 years, BMI 25.0kg/m ²	None	Maternal history of hip fracture
<i>Garvan > FRAX</i>						
9	21	98	M	Aged 82 years, BMI 27.6kg/m ² , fracture	3 falls in last 12 months, 3 fractures since age 50	Alcohol intake >3 units/day
66	20	86	M	Aged 85 years, BMI 23.8kg/m ² , fracture	2 falls in last 12 months, 2 fractures since age 50	
83	17	73	M	Aged 83 years, BMI 27.1kg/m ² , fracture	2 falls in last 12 months, 2 fractures since age 50	

Supplementary Table 4. Outlier case details, during comparison of FRAX and QFracture for 10-year risk of hip fracture.

Case	FRAX (%)	QFracture (%)	Sex	Risk factors considered by both FRAX and QFracture	Risk factors considered by QFracture but not FRAX
<i>FRAX>QFracture</i>					
51	15	12	F	Aged 78 years, BMI 24.5kg/m ² , fracture, alcohol >3 units/day	Alcohol 3-6 units/day
<i>QFracture>FRAX</i>					
106	8.6	44.9	M	Aged 89 years, BMI 27.2kg/m ²	Falls, dementia, type 2 diabetes, TIA, chronic kidney disease stage 4
110	9.4	44.7	F	Aged 90 years, BMI 30.1kg/m ²	Falls, dementia, chronic obstructive pulmonary disease, care home resident, sertraline
118	13	52.3	F	Aged 85 years, BMI 22.0kg/m ² , fracture	Falls, dementia, sertraline

Supplementary Table 5. Case details for two patients that sustained an osteoporotic fracture as defined by QFracture in 1-year prospective follow-up.

Case details (Age, sex, body mass index)	Risk factors	Fracture sustained	Predicted 1- year risk of major fracture (%)
Aged 83 years, F, BMI 23.7kg/m ²	Falls, stroke, type 2 diabetes, dementia, fractures, sertraline	L2 vertebra	4.3
Aged 81 years, F, BMI 24.5kg/m ²	History of falls, COPD, TIA, chronic kidney disease stage 4, low vitamin D	Right proximal humerus	3.0

Supplementary Table 6. Published studies comparing the performance of FRAX, QFracture and Garvan fracture risk calculators (AUC = area under curve; ROC = receiver operating curve).

Reference	Objectives	Findings and Conclusions
Sandhu et al., 2009	Retrospective evaluation of predictive accuracy of FRAX (using US and UK databases) and Garvan. 144 women (69 fractures and 75 controls) and 56 men (31 fractures and 25 controls) aged 60-90 years.	<ul style="list-style-type: none"> In women, the average 10-year risk of major fracture by Garvan was higher in the fracture than in the nonfracture group. In men, although Garvan yielded higher average probability of major fracture in the fracture group (0.32 vs. 0.14), the FRAX algorithm did not: FRAX-US (0.17 vs. 0.19) and FRAX-UK (0.09 vs. 0.12).
Bolland et al., 2011	Evaluation of FRAX and Garvan in older women. 1,471 postmenopausal women >55 years. 5-year prospective study.	<ul style="list-style-type: none"> Each calculator had only moderate predictive ability for both hip and major fractures. The extra clinical variables in the calculators did not appear to improve performance. FRAX with and without BMD calculated a lower fracture incidence across all age, BMD, and BMI subgroups. Garvan accurately estimated future fracture incidence in most subgroups.
Cummins et al., 2011	Comparison of FRAX and QFracture in 246 women aged 50-85 years who had recently suffered a low-trauma fracture compared with 338 female controls who had never suffered a fracture.	<ul style="list-style-type: none"> FRAX yielded higher scores for fracture risk than QFracture. Risk of major fracture was 9.5% for QFracture compared with 15.2% for FRAX. For hip fracture, risk was 2.9% for QFracture and 4.7% for FRAX. Correlation between FRAX and QFracture was $r=0.803$ for major fracture and $r=0.857$ for hip fracture.
Hippisley-Cox and Coupland, 2011	Comparison of FRAX and QFracture in a UK population of men and women aged 30-85 years. 1,183,663 women and 1,174,232 men.	<ul style="list-style-type: none"> FRAX resulted in higher hip fracture risk than QFracture.
Sambrook et al., 2011	Predicting fractures in an international cohort using risk factor algorithms without BMD. 19,586 women aged ≥ 60 years who were not receiving antiosteoporosis medication and were followed annually for 2 years.	<ul style="list-style-type: none"> Both FRAX and Garvan showed a moderate ability to correctly predict hip fracture. Neither algorithm was better than the model based on age and fracture history alone. Estimation of fracture risk in an international primary-care population of postmenopausal women can be made using clinical risk factors alone without BMD. More sophisticated models incorporating multiple clinical risk factors including falls were not superior to simpler models in predicting future fracture in this population.
Bolland et al., 2013	Discrepancies in predicted fracture risk in the elderly. Commentary on FRAX, Garvan and QFracture.	<ul style="list-style-type: none"> FRAX resulted in lower 10-year fracture risk in the elderly compared with QFracture. When considered alongside guidelines for treatment, different estimates could lead to variations in patients being offered treatment.
Dobson et al., 2013	Assessing fracture risk in 88 patients with multiple sclerosis (MS): a service development study comparing FRAX, QFracture and an MS-specific tool.	<ul style="list-style-type: none"> Mean 10-year fracture risk was 4.7% assessed by FRAX, 2.3% with QFracture and 7.6% using the MS-specific calculator. These differences were significant.
Van Geel et al., 2013	Risk prediction using FRAX and Garvan. A prospective population-based 5-year follow-up study of GP centres in the Netherlands. 506	<ul style="list-style-type: none"> Both tools, using BMD values, distinguish between women who did and did not fracture. Those who sustained a fracture had an estimated fracture risk $\geq 20\%$ using FRAX compared with 53.3% using Garvan.

	postmenopausal women aged ≥ 60 years.	<ul style="list-style-type: none"> Both calculators estimated lower fracture risks than those observed. Garvan showed higher sensitivity and FRAX showed higher specificity.
Leslie & Lix 2014	Review of the theoretical aspects for developing and validating the risk calculators FRAX, Garvan and QFracture.	<ul style="list-style-type: none"> Model development should follow a systematic and rigorous methodology around variable selection, model fit evaluation, performance evaluation, internal and external validation. Considers how risk prediction tools are integrated into clinical practice guidelines to support better clinical decision making and improve patient outcomes.
Pluskiewicz et al., 2014	10-year fracture prediction calculated using FRAX and Garvan in 801 osteoporotic men, mean age 70.8 years.	<ul style="list-style-type: none"> ROC analyses showed AUC for any fractures for FRAX was 0.808 and Garvan was 0.843 ($p = 0.059$). The AUC values for hip fractures were 0.748 for Garvan and 0.749 for FRAX.
Shribman et al., 2014	A service development study of the assessment and management of fracture risk in 77 patients with Parkinson's disease.	<ul style="list-style-type: none"> QFracture calculated significantly higher fracture risk scores than FRAX for hip and major fracture. ROC curves demonstrated that FRAX outperformed QFracture with an AUC of 0.84 for FRAX and 0.68 for QFracture major fracture risk.
Billington et al., 2015	Difference in 10-year hip fracture risk with FRAX and Garvan with BMD. 122 women. Age 60-90 years; mean 70.4 years	<ul style="list-style-type: none"> Hip fracture risk estimates were usually higher with Garvan than FRAX. These differences could impact on treatment decisions in an estimated 25% of patients.
Marques et al., 2015	Systematic review examining accuracy of currently available fracture risk calculators. 45 studies reviewed, covering 13 different tools.	<ul style="list-style-type: none"> Only FRAX, Garvan and QFracture had been tested more than once in a population-based setting: Twenty studies with these three tools were included in a total of 17 meta-analyses. FRAX has the largest number of externally validated and independent studies. The overall accuracy of the different tools is 'satisfactory', with QFracture displaying highest accuracy.
Aw et al., 2016	Comparison of FRAX and QFracture in 100 women attending an osteoporosis clinic.	<ul style="list-style-type: none"> The 10-year risk for major fracture as calculated by FRAX and QFracture were similar (17.0% and 15.8% respectively ($p=0.732$)). Risk of hip fracture was significantly different (FRAX 5.0%; QFracture 8.1% ($p<0.001$)).
Chen et al., 2016	Comparisons of 9 different screening tools (including FRAX and Garvan) for identifying fracture/osteoporosis risk among community-dwelling older people in Taiwan. (186 men, 367 women). Mean age 67.4 years.	<ul style="list-style-type: none"> FRAX had AUC of ≥ 0.8 in men, GARVAN had AUC of ≥ 0.8 in women. Garvan and FRAX displayed the best predictive ability of a fracture in both men and women than the other screening tools.
Dagan et al., 2017	External validation and comparison of FRAX, QFracture and Garvan for risk of osteoporotic fractures using data from population based electronic health records: retrospective cohort study of 1,054,815 men and women aged 50-90 years.	<ul style="list-style-type: none"> The areas under the ROC for hip fracture prediction were 82.7% for QFracture, 81.5% for FRAX, and 77.8% for Garvan. For major osteoporotic fractures, AUCs were 71.2% for QFracture and 71.4% for FRAX.
Gourlay et al., 2017	Comparison of FRAX, QFracture and Garvan in 4,994 men aged ≥ 65	<ul style="list-style-type: none"> Including BMD, the predictive ability to identify men with incident hip fracture was similar for FRAX and Garvan.

	years without hip or clinical vertebral fracture or antifracture treatment at baseline.	Without BMD, the discriminative ability to identify hip fracture was similar for QFracture and Garvan. <ul style="list-style-type: none"> • ROC curve analyses revealed better diagnostic accuracy for risk scores calculated with BMD compared with QFracture.
Akyea et al., 2019	Predicting fracture risk in patients with chronic obstructive pulmonary disease (COPD): a UK-based population-based cohort study. 80,874 COPD and 308,999 non-COPD patients matched by age, sex and general practice.	<ul style="list-style-type: none"> • ROC values for major fracture in COPD were FRAX: 71.4%, QFracture: 61.4% and for hip fracture alone, both 76.1%.
Crandall et al., 2019	Comparison of Garvan and FRAX in younger post-menopausal women (Women's Health Initiative Study). 63,723 postmenopausal women aged 50–64 years.	<ul style="list-style-type: none"> • At sensitivity thresholds $\geq 80\%$, specificity of both tools for detecting incident hip fracture during 10-year follow-up was low: Garvan 30.6% and FRAX 43.1%. At maximal area under the ROC curve, sensitivity was 16.0% for Garvan and 59.2% for FRAX. • Observed hip fracture probabilities were similar to FRAX-predicted probabilities but greater than Garvan-predicted probabilities. • For both tools, sensitivity for identifying major fracture was low (26.7–46.8%).
Holloway-Kew et al., 2019	Predictive ability of FRAX and Garvan in women (809) and men (821) aged 50–90 years, enrolled in the prospective Geelong Osteoporosis Study. 10-year follow-up.	<ul style="list-style-type: none"> • FRAX underestimated major fracture, regardless of sex or BMD. FRAX accurately predicted hip fractures, except in women with BMD. • Garvan underestimated fragility fractures except in men using BMD. Garvan accurately predicted hip fractures except for women without BMD. • ROC analyses suggest that Garvan with BMD performed better than Garvan without BMD for fracture prediction.
Desbiens et al., 2020	Comparison of FRAX, QFracture and Garvan in individuals with and without chronic kidney disease (CKD). Prospective study of 40-69 years recruited between 2009-2010. n=19,393 (9522 non-CKD; 9114 stage 2; 757 stage 3). 5-year follow-up.	<ul style="list-style-type: none"> • In non-CKD, stage 2 and stage 3 CKD, FRAX and QFracture predicted major fracture similarly. • The predictive ability of Garvan for any fracture tended to be lower in CKD stage 3 compared to non-CKD and CKD stage 2 with lower predicted fracture risks.
Lam et al., 2020	Evaluation of FRAX, QFracture and Garvan in prediction hip fracture in people ≥ 80 years and development of an 'elderly-specific' 10-year hip fracture risk algorithm. Retrospective cohort study. (n=251).	<ul style="list-style-type: none"> • The Hong Kong Osteoporosis Study Score can predict 10-year incident hip fracture among the most elderly in Hong Kong. • Garvan yielded higher fracture risks than FRAX and QFracture.