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Access to fracture risk assessment by FRAX and linked National Osteoporosis Guideline Group (NOGG) guidance in the UK - An analysis of anonymous website activity.

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Conflict of Interest statement

Eugene V McCloskey, Helena Johannson, Nicholas C Harvey and John A Kanis are involved in the development of FRAX. Eugene V McCloskey, Nicholas C Harvey and John A Kanis are also members of the NOGG Advisory Group and John A Kanis and Juliet Compston are members of the NOGG Guideline Group.

MINI ABSTRACT

Purpose/Introduction
In the UK, fracture risk guidance is provided by the National Osteoporosis Guideline Group (NOGG). NOGG usage showed widespread access through direct web-based linkage to FRAX. The facilitated interaction between fracture risk assessment and clinical guidelines could usefully be adopted in other countries.

ABSTRACT

Purpose/Introduction
In the UK, guidance on assessment of osteoporosis and fracture risk is provided by the National Osteoporosis Guideline Group (www.shef.ac.uk/NOGG). We wished to determine access to this guidance by exploring website activity.

Methods
We undertook an analysis of FRAX and NOGG website usage for the year between 1st July 2013 and 30th June 2014 using GoogleAnalytics software.

Results
During this period, there was a total of 1,774,812 sessions (a user interaction with the website) on the FRAX website with 348,964 of these from UK-based users; 253,530 sessions were recorded on the NOGG website. Of the latter, two-thirds were returning visitors, with the vast majority (208,766, 82%) arising from sites within the UK. The remainder of sessions were from other countries demonstrating that some users of FRAX in other countries make use of the NOGG guidance. Of the UK-sourced sessions, the majority were from England, but the session rate (adjusted for population) was highest for Scotland. Almost all (95.7%) of the UK sessions arose from calculations being passed through from the FRAX tool (www.shef.ac.uk/FRAX) to the NOGG website, comprising FRAX calculations in patients without a BMD measurement (74.5%) or FRAX calculations with a BMD result (21.2%). National Health Service (NHS) sites were identified as the major source of visits to the NOGG website, comprising 79.9% of the identifiable visiting locations, but this is an underestimate as many sites from within the NHS are not classified as such.

Conclusion
The study shows that the facilitated interaction between web based fracture risk assessment and clinical guidelines is widely used in the UK. The approach could usefully be adopted in other countries for which a FRAX model is available.

Key words: FRAX, fracture risk, assessment, guidance, NOGG, BMD

BACKBROUND AND AIMS

FRAX, an online algorithm (www.shef.ac.uk/FRAX) to determine an individual's 10-year fracture probability, has been available since April 2008. It integrates the weight of important clinical risk factors for fracture and mortality risk, with or without information on BMD, and is now available for 57 countries potentially covering 79% of the global population age 50 years or more. FRAX is now incorporated into many national and international guidelines for the assessment of fracture risk and/or the management of postmenopausal and glucocorticoid-induced osteoporosis [1-12]. In the UK, FRAX is one of two fracture risk assessment tools included in guidance by the National Institute for Health and Clinical Excellence (NICE) and the Scottish Intercollegiate Guideline Network (SIGN)[13, 14].

In late 2008, the National Osteoporosis Guideline Group (NOGG) in the UK provided FRAX-based guidance and thresholds for the assessment of BMD and the need for therapeutic intervention[15] with a further update in 2013[16]. The NOGG guidance was also provided in an online format (www.shef.ac.uk/NOGG) and linked to the FRAX UK calculation tool by a button that could be pressed by the individual undertaking the risk assessment; this system remains in place today. In the absence of BMD input to the FRAX calculation, this action transfers the probability of major osteoporotic fracture (hip, clinical vertebra, wrist and proximal humerus) to the NOGG algorithm webpage to determine if a patient can be simply reassured, initiated on treatment or referred for a BMD measurement for further characterization of risk. In the presence of BMD input, the probabilities of both hip and major osteoporotic fracture are transferred to the NOGG algorithm webpage. Similar electronic linkages have now been implemented in several countries (e.g. Finland, Lebanon, and Romania), whereby the online output of FRAX is automatically compared to independent country-specific guidelines to facilitate treatment decisions according to local guidelines.

The purpose of this study was to undertake an analysis of UK-based usage of the FRAX and NOGG websites as an indicator of access to the current guidance.

METHODS

Both the FRAX website and the NOGG website are monitored using GoogleAnalytics software that enables exploration and documentation of website activity, patterns and sources. For this study, we assessed usage of the FRAX and NOGG websites by undertaking an analysis of the number of sessions of website activity, and the geographical source of that activity, using GoogleAnalytics. We have used a similar approach in a previous study of global FRAX usage[17]. Briefly, GoogleAnalytics determines locations from a visitor's IP address and counts each visit as a session number. The data are based not on risk calculation count, but on the number of sessions (the latter captures a single user interaction with the website); it is important to note that the session rate is lower than the calculation rate, as more than one calculation may be conducted by the same user during one session. Data at the country level are described as accurate worldwide; it is believed that access via mobile devices or VPN can lead to inaccuracies in tracking the source, but usually within the country of origin (e.g. assigned to the wrong city). FRAX and NOGG usage

was computed as the number of sessions originating from within the UK as a whole and also examined at nation and city level. NHS users were classified by the finding of 'nhs' in the IP address assigned to the source accessing the websites.
The number of sessions over the index period of one year (1st July 2013 to 30th June 2014) was divided by the population over the age of 50 years for the year 2015 using demography from the UN [UN 2015] (medium variant) and expressed as calculations/million.

RESULTS

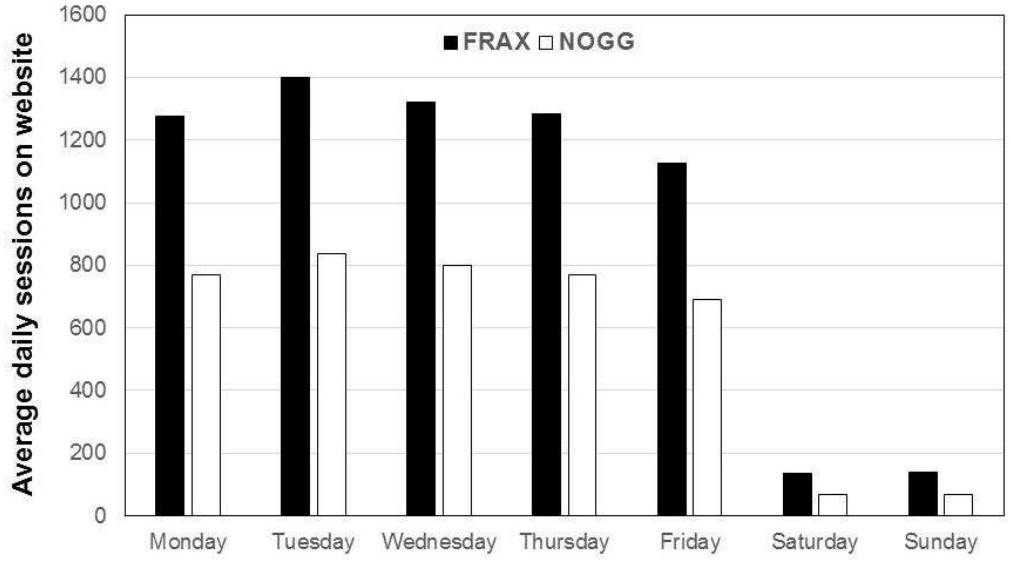
During the one year period a total of 1,773,812 sessions was recorded on the FRAX website from all users around the world. The UK was the second largest user in terms of absolute numbers of sessions (Table 1), with 19.7% of the total sessions originating from there. The majority of UK sessions (284,686, 81.6%) arose from service providers identified as within the National Health Service.
During the same period, there was a total of 253,530 sessions recorded on the NOGG website with the majority of these (208,766; 82.3%) arising from within the UK (Table 1). Two-thirds (67.4%) of the latter were classified as returning users by Google Analytics. NHS-based service providers were again identified as the major source of UK sessions (166,859; 79.9%) on the NOGG website. Of the remaining 44,764 sessions on the NOGG website, half were from users in the United States (Table1).

Table 1. *Usage of the FRAX and NOGG websites according to the absolute number of sessions from the top 5 countries in the year 1st July 2013 to 30th June 2014.*

	FRAX		NOGG	
	Country	**Total sessions**	**Country**	**Total sessions**
1	United States of America	753,262 (675)	United Kingdom	208,766 (891)
2	United Kingdom	348,964 (1489)	United States of America	22,591 (20)
3	Japan	65,338 (114)	Ireland	2,986 (149)
4	Canada	61,215 (455)	Slovenia	2,378 (289)
5	Spain	57,033 (319)	Canada	1,948 (14)

For UK users, the FRAX and NOGG sites both showed a strong weekly pattern of access with low rates at the weekend and substantially higher rates Monday to Friday (Figure 1). For example, the FRAX website showed an average of 956 sessions per day but this comprised an average of 1282 sessions per weekday and an average of 137 per day at the weekend. The daily average number of sessions on the NOGG website was 572, comprising an average of 773 sessions per weekday and an average of 68 per day at the weekend.

Figure 1. *Weekly pattern of use of the FRAX and NOGG websites by UK-based users during the period 1st July 2013 to 30th June 2014. Bars represent the mean number of sessions recorded on each site.*



Of the UK-sourced sessions, the majority on both the FRAX (77.6%) and NOGG (78.4%) websites were from England (Table 2). It is important to note that after adjustment for the populations of each nation aged 50 years and over, the session rate (per million) was highest for Scotland with lowest rates seen in Wales and Northern Ireland and intermediate rates in England.

Table 2. *Usage of the FRAX and NOGG websites within the UK according to the absolute number of sessions and session rate (sessions per 1,000,000 of population aged 50 years and over) in the year 1st July 2013 to 30th June 2014.*

Country	FRAX sessions	NOGG sessions	Population aged 50 and over	FRAX session rate	NOGG session rate
England	270,748	163,749	14,829,804	18,257	11,042
Scotland	55,999	32,740	1,936,000	28,925	16,911
Wales	14,384	7,677	1,155,951	12,443	6,641
Northern Ireland	7,784	4,586	574,215	13,556	7,986

Geographical data within GoogleAnalytics demonstrated widespread usage of both websites throughout most of England and the more densely populated areas of Wales, Scotland and

Northern Ireland. The pattern of locations was virtually identical for both websites suggesting concomitant use of FRAX and NOGG (data not shown). The 15 top ranking cities and towns in the UK for absolute numbers of sessions to the FRAX website and the same locations' visits to the NOGG website are shown in Table 3. Sessions on the NOGG website as a proportion of sessions on the FRAX website varied from 48.1% in Cardiff to 71.3% in Manchester.

Table 3. *The top 15 UK cities and towns accessing the FRAX and NOGG websites in the 12 month period. The number of NOGG sessions is also expressed as a proportion of the total FRAX sessions from each location.*

Ranking	City/Town	FRAX Sessions	NOGG Sessions	NOGG/FRAX (%)
1	London	59,376	30,351	51.1
2	Sheffield	44,639	30,131	67.5
3	Glasgow	44,161	25,788	58.4
4	Manchester	22,008	15,695	71.3
5	Leicester	15,420	9,810	63.6
6	Cardiff	11,944	5,743	48.1
7	York	11,692	6,614	56.6
8	Nottingham	10,099	6,994	69.3
9	Oxford	9,275	5,003	53.9
10	Tamworth	7,244	4,756	65.7
11	Edinburgh	6,605	3,945	59.7
12	Belfast	6,361	3,676	57.8
13	Derby	5,848	3,878	66.3
14	Chelmsford	5,766	3,503	60.8
15	Norwich	5,055	3,319	65.7

Nearly all (95.7%) of the NOGG sessions from the UK arose from calculations being passed through from the FRAX tool for guidance on the interpretation of FRAX probabilities. This comprised FRAX calculations in patients without a BMD measurement (155,000; 74.5%) or FRAX calculations with a BMD result (44,000; 21.2%). A minority of sessions was conducted for other reasons (manual calculations, document downloads, FAQs etc.).

DISCUSSION

Our analysis suggest that there is good linkage between the use of the FRAX fracture risk assessment tool and the National Osteoporosis Guideline Group's advice on management of osteoporosis in the UK. The majority of use arises from within NHS facilities and most calculations using the FRAX tool are undertaken in the absence of BMD, presumably as an initial assessment of fracture risk in line with NICE guidance[13]. Bearing in mind that a single session may include calculations on more than one individual, the data would suggest that the FRAX tool is being used to assess fracture risk in almost 1300 people each weekday

in the UK. At least 750 people have their osteoporosis management passed through the NOGG website on each weekday.

While there is wide provision of clinical guidelines in many chronic diseases, the uptake and use of such guidance varies enormously. There are many hurdles to overcome in optimising the use of guidance, ranging from awareness of its existence to implementation and impact on individual care. Low awareness will always result in low adherence but, even with detailed plans and processes for implementation, clinician knowledge of such guidelines is relatively low world-wide for osteoporosis[18-21] and other chronic diseases. Education is obviously important but its effectiveness can be disappointing; for example, a Cochrane review reported that continuing medical development meetings led to only relatively small improvements in practice and patient outcomes[22]. The wider use of electronic health care systems and health records may lead to improved adherence to clinical guidance due to automation. Certainly computer-generated reminders appear to improve adherence to protocols[23]. A number of guidelines also provide clinical decision support systems, usually in the form of software programs, to assist with uptake and implementation. Such point-of-care computerised advice has been shown to improve treatment with a variety of drugs, including anticoagulants, insulin, and antibiotics[24]. The FRAX and NOGG websites have incorporated some of these methods. For example, both are discussed frequently at clinical education meetings in the UK as well as in regular published updates that are provided free through the NOGG website. The NOGG guidance has also been endorsed by a large number of appropriate clinical and patient societies. Prompts and reminders are built into the system; for example, if a FRAX risk assessment for a 76 year old woman with a prior fracture is passed through to the NOGG website, an automated reminder pops up to remind the clinician that such a patient can be considered for treatment in the absence of a BMD measurement. One might argue that the result from FRAX should automatically trigger the transfer of the result to the NOGG website but this remains voluntary and at the discretion of the clinician. It is notable however that the use of the NOGG website is almost entirely driven by FRAX activity. The reason for the higher use of FRAX and NOGG in Scotland compared to elsewhere in the UK is unclear. The use is evenly distributed across the major population centres in Scotland, suggesting that this does not reflect a different policy in one city or region of the country. One might speculate that it could relate to more limited access to densitometry services, but we currently have no data to support this suggestion.

Our study has several limitations. Whilst showing widespread usage of both tools, the metric that we have captured is visits to the websites from within the UK. Each of these visits or sessions may contain one or more calculations and therefore underestimates the number of risk assessments. Some measure of this can be garnered from the difference between the number of actual calculations per annum on the FRAX website (captured by a dedicated calculation counter on the website) and the total session number. The counter has recorded 2.6-2.7 million calculations per year for the last several years but the total number of sessions in 2013-14 was only approximately 1.8 million. A further limitation is that the web site is not the sole portal for the calculation of fracture probabilities. For example, FRAX is available on BMD equipment and on smartphones. Website activity will not capture usage of FRAX on bone densitometers and, therefore, provides an additional underestimate of the number of risk assessments. As stated previously, mobile phone/computer usage may lead to incorrect geographical allocation, albeit usually within

the same country. In addition, the analysis captured sessions on the FRAX website from visitors located within the UK, but some of these may have been using calculators other than the UK calculator. This would occur, for example, in the case of ethnic minority or immigrant patients within the UK where current evidence suggests that the use of national tools may be inaccurate and the use of more ethnic-appropriate calculators is advised[25]. This may provide, at least in some part, an explanation for the greater use of FRAX than NOGG as the latter is only available on the UK calculation tool.

The present analysis cannot determine whether the use of FRAX and NOGG is always targeted to appropriate people (i.e. those with risk factors), and it is not possible to say what proportion of the at-risk population is assessed. Finally, we are unable to examine the impact of the combined use of FRAX and NOGG on treatment uptake and/or fracture reduction in those at highest risk. This important question is, however, being addressed in a large, 7-centre, randomised study comprising over 13000 women aged 70-85 years in the UK, funded by MRC and ARUK. The Screening for Osteoporosis in Older People (SCOOP) study will compare treatment uptake and fracture rates in women randomised to receive standard care against those in women assessed by the FRAX tool with targeting of intervention based on a forerunner of the NOGG thresholds[26]. It is anticipated that this study will report in the not too distant future.

We conclude that this analysis shows widespread and linked use of the FRAX and NOGG approaches to assessing and managing fracture risk in people in the UK. The approach is one that could readily be applied in other countries through the existing FRAX models, an option that has already been exercised by several countries (e.g. Finland, Lebanon and Romania). The impact on appropriate prescribing and fracture rates should be the focus of future studies.

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