**Paediatric Free Open Access Medical Education (FOAM) – Behaviours, Trends and Implications**

**Short Title:**

Paediatric FOAM - Behaviours, Trends, Implications

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**Abstract**

Introduction

Free Open Access Meducation describes online resources assisting learning in medicine. Little is known about users or their behaviours.

Methods

Using Google analytics for www.paedatricfoam.com we explored user demographics and their patterns of behaviour.

Results

25,583 sessions were logged over four months in 2018/2019. 68.9% of users were female; most were 25-34 years; 57.3% used a mobile device. Mobile users were more likely to arrive on the site via search engines or twitter, and 84.3% of mobile users left the site after viewing a single page. Users came from 146 countries, although the site is written and promoted in the UK only.

Discussion

FOAM is a rapidly developing form of medical education, with large user numbers seen for a site just 2 years old. The site is being used by many beyond its intended readership and primarily being accessed from search engines.

Conclusions

Google analytics can powerfully explore FOAM usage. Site curators should develop materials suitable for mobile or desktop usage, mindful also that their readership may well not be professional at all. Given its popularity, further evaluation of user motivations and the effectiveness of FOAM should be prioritised.

**Keywords**

Free Online Open Access Meducation; FOAM; Medical Education; Social Media; Undergraduate Medical Student.

**Introduction**

Free Open Access Medical Education (FOAM) describes the use of social media for medical education (Nickson & Cadogan 2014). More broadly it describes the community and ethos of information sharing to enhance medical education both using online social media and other modalities (Nickson & Cadogan 2014). FOAM modalities include blogs, podcasts, e-texts and websites, as well as resources less conventionally associated with education such as Twitter and Facebook (McGowan et al. 2012; Cadogan et al. 2014; Carroll et al. 2016; Burkholder et al. 2018).

Emergency Medicine and Critical Care Specialities have been at the vanguard of FOAM (Mallin et al. 2014) with Cadogan et al. (2014) identifying over 180 sources of FOAM in 2014, and since then the number has grown substantially. As its name suggests, FOAM is wide-reaching, and used worldwide in countries of varying economic status (Thurtle et al. 2016). A substantial number of clinicians in developed countries are believed to be using FOAM (Barnes et al. 2019).

Research in FOAM has not matched the exponential growth in its use. Only one review of its effectiveness has been published to date (Cheston et al. 2013). Whilst suggesting potential benefit of FOAM as a learning method, it highlighted the need for further research. There has also been limited research into the differences in how users interact with different forms of FOAM (Cheston et al. 2013). Unsurprisingly, FOAM users strongly support its use (Lien et al. 2018) and note similarities with self-guided education and internet-based education where effectiveness has been better demonstrated (Murad et al. 2010; Lin et al. 2016). FOAM can be seen to help educators implement and adapt other evidence-based teaching strategies such as flipped classroom models (Chen et al. 2017) or journal clubs (Roberts et al. 2015), also allowing users to critically evaluate FOAM resources during their learning.

Currently, published evidence on the use and effectiveness of FOAM is virtually non-existent in paediatrics. Though recognised within commentaries on the topic (Zaver et al. 2016; Baker et al. 2016), published peer-reviewed research on FOAM in paediatrics is limited to short term intervention studies (Gates et al. 2018) and case studies (Sinton et al. 2016) Even in the more popular specialities for FOAM (Emergency Medicine and Critical Care) current evidence on user behaviours are typically based around self-report data (Barnes et al. 2019) which presents its own issues and associated biases. The limited amount of published data on user behaviour is somewhat surprising, as due to the nature of FOAM there is great opportunity for collection and evaluation of its user behaviours (Barnes et al. 2019). Carley et al. (Carley et al. 2018) demonstrated how this could be done, publishing data on user engagement on “St Emlyn’s Blog”. This highlighted the exceptional growth potential and worldwide reach of FOAM platforms. Two other recent studies have presented similar data in relation to podcast engagement (Chin et al. 2017; Patrick et al.). Twitter may have even greater potential for analysis, particularly when correlating engagement data with face-to-face events and educational activities (Lulic & Kovic 2013; Roland et al. 2017).

Currently, very little is known about the users of FOAM and their behaviours when they interact with FOAM sites. We do not know how users find articles, whether this process uses search engines or whether users access FOAM sites not akin to an online newspaper. We do not know who the users are and why they access FOAM rather than other sources of information, nor do we know how this relates to more formal educational or training programmes.

Whilst evidence is starting to accumulate in Emergency Medicine, this has not been the case for other specialities. We sought to explore patterns of use of one of the two major paediatric FOAM sites, so assisting the development of FOAM and highlighting areas for future research.

**Methods**

***Development of Paediatric FOAM***

www.paediatricfoam.com was started in 2016 by trainees and consultants within the London School of Paediatrics. The intention was to promote “participation and contribution”, creating an evolving, dynamic, regularly changing section of educational material (www.paediatricfoam.com 2019).

The site now has \*\* articles, written by \*\* contributors. Although not formally peer reviewed, articles are fact checked by a subject matter expert and edited for style. Comments are enabled on all articles, encouraging ongoing informal peer review.

***Data Collection and Analysis***

Paediatricfoam.com uses the WordPress platform, allowing recording and evaluation of user data using Google Analytics. Data collected includes basic user demographics and location, site behaviours such as duration of time on specific site pages, pages per session and transitions between pages, device used and bounce rate (the degree to which users leave the site after viewing the page they land on, rather than access other pages within the site).

Data was extracted between the dates 11th December 2018 and 30th April 2019 and exported to Microsoft Excel for basic analysis. Due to the nature of study design, descriptive statistics were deemed the most appropriate for this initial analysis. Data are presented as mean (standard deviation), or as mean only when standard deviation data was not accessible via the Google Analytics platform.

**Results**

25,583 sessions were logged (mean daily users = 181.44; SD = 75.16) during the study period. Demographic data was available for 6594 users of which 4543 (68.9%) were female. There was no observable difference of note in user behaviours by gender.

Age category distribution is presented in Fig 1.

**INSERT FIGURE 1 HERE.**

Device data was available for 21,121 users of which 12,098 (57.3%) accessed the site using mobile devices, 8204 (38.8%) desktop devices, and 819 (3.8%) tablet devices. Mean session duration was 73.55seconds, and this was similar across age groups and genders.

Users accessing the site via mobile devices also viewed fewer pages per session and had lower total session duration than those accessing the site using tablet or desktop (Table 1).

**INSERT TABLE 1 HERE.**

Users arrived at the site from a number of sources (Fig 3). The majority of users found articles using search engines (53.2%), and 20.9% of users came via social networking sites such as Twitter and Facebook. The device used to access the site was associated with the pages viewed. 98.2% of traffic accessing the site via the most viewed page originated from mobile devices. Those landing on the site’s homepage were mostly using desktop devices (63.44%) whereas, of those accessing the page providing information on career development 50% were using mobile devices and 50% were using desktop devices.

**INSERT FIGURE 2 HERE.**

Day of the week influenced user number (Fig 3). At weekends there were fewer visitors, although they had a similar bounce rate to those visiting the site during the middle of the week.

**INSERT FIGURE 3 HERE.**

Despite the site and almost all of its contributors being based in the UK, paediatricfoam.com was access by users from a total of 146 countries (Fig. 4).

**INSERT FIGURE 4 HERE.**

**Discussion**

This study is the first to explore the users of FOAM and their behaviours in detail. It demonstrates the breadth of data and also the limitations of using website “click data” in research. Although it answers some questions, many more are either raised or left unanswered. When we started this investigation, it was primarily intended to better understand who was reading the articles on the site, however they found them and how they used the site.

We found that even after just 2 years as an active site, it was attracting substantial usage, with a mean daily visitor number of 181.4 (75.2). Little has been reported to compare this to more established journals, although Perneger (2004)reported an average daily hit rate of 97.8 for articles in the British Medical Journal (impact factor 27.6) in the first week of publication. This usage is less than reported by Carley et al. (2018) on their FOAM site, the only other comparable data. There are a plethora of potential reasons for this ranging from the clinical area, establishment of the site, site design, promotion, and search engine optimisation. The effect of these in the context of FOAM is largely unknown.

We saw users were diverse in age, in keeping with several other reports (McGowan et al., 2012; Cadogan et al. 2014; Thurtle et al., 2016; Bucher et al., 2018; Burkholder et al., 2018; Barnes et al., 2019). 68.9% of users were female contrasting with the one large scale study that assessed physician FOAM usage where there was a bias towards the male population (McGowan et al., 2012). Although this is not indicative of increased engagement with FOAM in this demographic group (Yoo et al., 2013). For age, the largest group of paediatricFOAM users were 25-34years old. Both of these findings are likely to reflect the predominant demographic of paediatric trainees in the UK. McGowan et al. (2012) and Yoo et al. (2013) have suggested that there may be some effect of age and seniority on how individuals used the site, although we found no relationship. This number will aggregate those who finish articles, and those who spend very little time in order to see that the article is not what they were looking for, or just read the first section. We also saw that mobile phones were the most used device to access the site, and that those using them were much more likely to arrive from a search engine. This high proportion may be linked to the largest group of users – known to be active mobile phone users (Duggan 2015; Tsetsi & Rains 2017). It may also be that the site is being used as a ‘just in time’ source of information, suggested by the high bounce rate of those using mobile phones on the site. Nakamura (2013) identified a similar difference in bounce rate in their study of an internet-based education site in a field other than medical education. This suggestion might also account for the higher user numbers during weekdays as opposed to weekends.

These findings and suggestions of course relate to a brief period in the life of a single FOAM site. It may be that other disciplines have different user behaviours, or that when more mature, users will approach the site differently. The findings are all directly imported from Google Analytics, so are as good as the information Google gathers. For instance, the gender and age relate to the owner of the phone, and others may use the phone. Session duration is also not the same as time spent reading an article. There were also quirks within the data. For instance, the most viewed landing page (umbilical granulomas) had an unusual 98.2% of traffic from mobile devices. This page presents 4th on Google search results at time of submission. Potentially, parents of children with this condition may be accessing the FOAM site, and they may present a very different type of user to that accessing the rest of the site. Such considerations are a hazard in research on the internet. As all FOAM is by definition open access, we would expect all FOAM sites to have users beyond the intended group and excluding these from analysis would create a false view of the site’s performance.

**Conclusions and Future Research**

An understanding of who is accessing FOAM and why they are doing so has not kept pace with its rapid development. We have shown a paediatric site primarily targeting trainees based in London has a broad spread of users across ages and countries, many of whom were accessing the site outside of typical working hours. That said, the majority of users were female, 25-34 years old, used mobile phones and did so Monday to Friday, as would be expected from the target users.

We learnt that mobile users also outnumbered other user devices and saw that the way users accessed the site was related to behaviour. Desktop and tablet users started with the homepage more often than those on mobiles, who came from social media and search engines. Put together, this gives a different picture of how users may access FOAM from that perhaps existing in site hosts minds – that of individuals coming to the site homepage and working through the content. Rather, the majority of users appear to read an individual article, probably only partially, and then leave.

Perhaps the clearest message from this investigation is around the tool itself. Google Analytics can effectively document users and their behaviours, so can be used as an investigative instrument in its own right. This could extend beyond collecting information about user behaviour to potentially investigating how altering site content or promotion changes activity.

It is also clear that there is a lack of information in this area despite its rapid growth and reach within the medical community. We hope that our findings have made a small contribution to the knowledge of how FOAM is being used. There is a pressing need for further research especially into the effectiveness of FOAM and social media on learning outcomes. With a growing user community, FOAM is already being widely used and probably explicitly included in curricula without understanding of best practice or even its benefit to learners. So, choice of FOAM resources may be based more on recommendation and prior experience than any form of validation.

Further investigation could involve:

* Documenting the prevalence and usage of FOAM across the spectrum of medical specialities and user groups.
* Delineating types of FOAM and the way in which these are generated and validated.
* Understanding how learners are using FOAM in their professional development or clinical practise.
* Exploring what approaches are most useful for learning.

As these studies would have more generalisable findings. If such investigations crossed specialities, training groups and types of FOAM.

**Practice Points**

**1 FOAM sites have become an important source of medical information.**

**2 Those writing for or curating FOAM should prepare materials so they are easy accessed from desktop and mobile devices.**

**3 Search optimisation is important as a high proportion of traffic is from search engines or twitter.**

**4 FOAM is global, with a reach far beyond the typical intended audience.**

**5 Google analytics is a powerful and simple to use tool for evaluating the use of online educational materials.**

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**Illustrations and Tables**

***Table 1***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **User Device** | **Daily Visitors** | **Bounce Rate (%)** | **Pages per Session** | **Session Duration (s)** |
| Mobile | 107.3 (59.6) | 84.3 | 1.32 | 62.4 |
| Desktop | 66.7 (23.3) | 77.4 | 1.7 | 91.6 |
| Tablet | 7.4 (4.2) | 80.2 | 1.58 | 79.6 |
| Table 1: Visitors, Bounce Rate, Pages per Session and Session Duration by User Device. | | | | |

***Figure 1***

Figure 1: Age Category Distribution of Users.



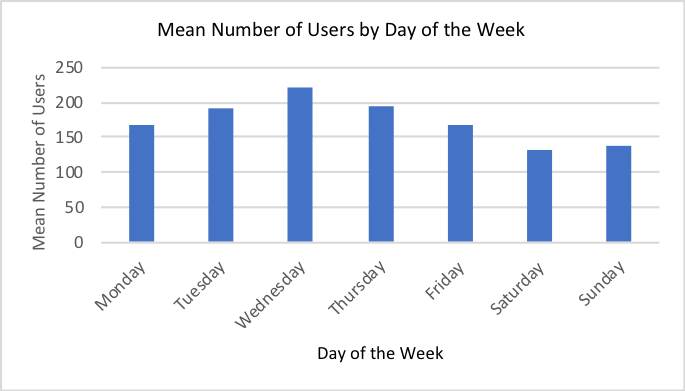
***Figure 2***

Figure 2: User Referral Source by Device.



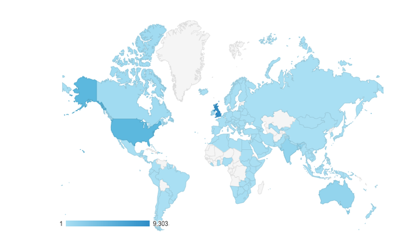
***Figure 3***

Figure 3: Mean Number of Users by Day of the Week



***Figure 4***

Figure 4: Global distribution of www.paediatricfoam.com Users.



**Acknowledgements**

**INSERT.**

**Declaration of Interests**

Dr Knight is the lead editor for www.paediatricfoam.com

Dr Round is an editor for www.paediatricfoam.com

Neither benefit financially or materially in any way from the website.

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