SYSTEMATIC REVIEW

Social Media use within medical education: A systematic review to develop a pilot questionnaire on how social media can be best used at BSMS [version 1]

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Abstract
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Background: Since the early 2000s social media has become a major part of our daily lives, and over the past decade it has found its way into the medical profession. Despite its ubiquity, only 5 systematic reviews exist on the subject of social medial use within medical education. The reviews conclude that there are positive correlations linked to social media use however the studies are restricted by the same limitations: a lack of quantitative data and the fact that social media research fast becomes outdated. This review will therefore examine the latest studies in order to identify which questions remain to be answered and what areas need further development in order for social media to become a credible resource within medical education. The information gained from this process will be amalgamated to create a valid questionnaire which will produce quantitative data.

Methods: A systematic review of Pubmed, Cochrane, PsychINFO, ERIC & Scopus was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The search was from 1st January 2014 to the 12th January 2017 and included keywords linked with social media and medical education. 27 papers were identified: 12 qualitative and 15 quantitative. From this data a questionnaire was drafted and put to a focus group in order for it to be validated.

Results: Six major themes were identified and analysed: community & interactivity, communication & feedback, learning theories, social media vs traditional didactic lectures, role of faculty and professionalism. Quantitative data was limited but highlighted the

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efficiency of social media use especially when Facebook and Twitter were used. After the analysis a validated questionnaire was produced.

Conclusion: Social media can be a useful tool within the medical curriculum if implemented correctly. The final questionnaire can be used to generate quantitative data on the following questions: which platforms are most effective and for what purposes? How beneficial is social media to teaching? and What do students understand the benefits/disadvantages of academic social media platforms to be?

Keywords
Social Media, Medical Education, Facebook, Twitter, Systematic Review
Introduction

Social Media and its Platforms

Social media is defined as all “websites and applications that enable users to create and share content, to interact with other users or to find people with similar interests to one’s own” (Waite and Dictionaries, 2015). The term encompasses multiple platforms ranging from blogs/microblogs (Twitter®) through to wikis, YouTube® and social network sites such as Facebook®.

Blogs are the equivalent of online diaries where the author posts in chronological fashion. People who visit these blogs are in turn allowed to comment and reply to the posts (Hollinderbäumer et al., 2013). Twitter is considered to be a microblog as each post is limited to 140 characters (Twitter®, San Francisco, CA). According to Cheston et al. (2013) blogs are the most widely used form of social media within medical education. These are followed closely by wikis. Wikis are similar to blogs with the exception that all users are allowed to edit the page. The most famous example is Wikipedia® with over 5.3 million published articles and averaging 800 new articles a day (Wikipedia, 2017).

Social network sites allow users to create personal profiles online, where they can share information, music, videos, thoughts and opinions. They can be private if the user choses to apply restrictions. This is achieved by choosing specific privacy settings. Alternatively, a public page can be created for all to see (Hollinderbäumer et al., 2013). Facebook is the most widely used social network site (Facebook®, Palo Alto, CA). The last major platform of note is YouTube®, which allows users to create and upload videos to the site (YouTube®, LLC, San Bruno, CA). There is then a comments section for people to discuss and share ideas.

Social Media in Medical Education

Despite the creation of social media’s flagship website ‘Facebook’ in 2004 it has taken over a decade for it to find its way into medical education (Pander et al., 2014). Currently, according to the literary databases Pubmed, Scopus and Cochrane, there exist only five systematic reviews that assess the role of social media within medical education. Three of them were published in 2013 (Cartledge et al., Cheston et al. and Hollinderbäumer et al.) whilst the other two were published in 2014 (Pander et al.) and 2015 (Roy et al.) respectively. The fact that five different systematic reviews were all published within two years of each other is indicative of the current topicality of this theme.

Since the last published systematic review (Roy et al., 2015) Facebook use has grown by 38%, and currently has over 1.86 billion users worldwide (Noyes, 2017; Statista, 2016). With a yearly user increase of 17% Facebook, and social media, shows little sign of slowing down (Facebook, 2017). In conjunction with the exponential growth of social media medical schools are now observing an increase of applicants from the ‘Net generation’ (Kennedy et al., 2008). These are individuals that have been exposed to digital technologies from a young age and, for the majority, use social media on a daily basis or even as their primary source of information (Bennett et al., 2008; Pander et al., 2014). Whilst most current research is posing the question, “should we incorporate social media into medical education?” it may be more pertinent to ask, “how best can social media be incorporated into medical education?”

Positive Impact of Social Media

The five systematic reviews address a number of themes from nearly a decade of studies and find that social media use is beneficial when integrated into the medical curriculum. Social media platforms allow for faster feedback between students and faculty members in and outside of the classroom (Cheston et al., 2013; Hollinderbäumer et al., 2013). This increases the speed of access to information therefore enhancing learning efficiency. The speed and ease of communication was also associated with an increase in student satisfaction (Pander et al., 2014). This is not only an advantage at the place of study, as the use of social media allows students to transcend geographical barriers, with Cheston et al. (2013) finding that students were tweeting academics from other continents and getting replies almost instantaneously.

Throughout the studies, students from various universities highlighted that using social media was a more active process than traditional didactic lectures. They felt more confident in terms of knowledge and more able to readily discuss topics and share their thoughts (Hollinderbäumer et al., 2013). This increased learner engagement and stimulated interactivity between the students, which in turn generated more content and ultimately improved grades (Cheston et al., 2013). Although the studies addressed in Cheston et al.’s review (2013) did not score highly on the Medical Education Research Study Quality Instrument (MERSQI), a tool designed to evaluate quantitative educational studies, these results are still encouraging and merit further research into the use of social media. One of the more rigorous studies found that e-learning was as effective as traditional learning techniques and that social media would build on the positive foundations of e-learning (Cheston et al., 2013). This is, in part, due to the versatility and customisable nature of social media which can be tailored to the learner’s needs (Dabbagh and Kitsantas, 2012).

Johnson et al. (2011) explain how social media has helped create Personal Learning Environments (PLEs). These are student-designed learning approaches that incorporate various tools (videos, apps, games, pictures..) selected by a student...
to match their personal learning style and pace. The aim is for students to have an increasing amount of control over how they learn. For example a visual learner would gain more from watching a video on YouTube than listening in a lecture. DiLullo et al., (2011) found that students performed better when they were in charge of their learning. However, PLEs still remain mostly theoretical as they are not widely implemented (Johnson et al., 2011).

Finally, the systematic reviews pointed out that teaching students how to use social media was good preparation for their professional life. As the world becomes more interconnected, global social media usage is a skill that future doctors will need to master (Hollinderbäumer et al., 2013). The five systematic reviews focused on undergraduate studies but a number of important papers looking at Twitter usage between physicians exist (Rouprêt and Misraï, 2015; Widmer et al., 2016). Social media is slowly becoming a mainstay of the medical profession. Therefore it is thought that students should be taught how to use it professionally in order to potentiate the benefits whilst simultaneously limiting any complications or unfavourable effects (Kind et al., 2014).

**Negative Impact of Social Media**

Patients are now also using social media to speak to members of the healthcare profession and are more informed than ever. Hollinderbäumer et al.’s study (2013) shows the benefits of this by highlighting the knowledge and understanding that students gained from reading about patient’s experiences. There are however many concerns about privacy and professionalism (Cheston et al., 2013; Hollinderbäumer et al., 2013; Pander et al., 2014). Pander et al. (2014) found that 0.2%-16% of students had behaved in an unprofessional manner. Despite the heterogeneity of the results this highlights a widespread issue. The behaviour was linked to Facebook and included various inappropriate statuses, uploading of unprofessional profile pictures as well as confidential information. Students were also members of groups that had criminal connotations. These ideas are briefly echoed in Cheston et al.’s study (2013). Patients are known to search for their doctors online. It is therefore important for students to act in a professional manner at all times and maintain their privacy (GMC, 2013; Hollinderbäumer et al., 2013).

Roy et al.’s review (2015) found that the negative impact of social media on medical professionalism was the greatest hurdle. These views were felt throughout the profession and meant that many lecturers were reluctant to adopt social media into the undergraduate curriculum. However, Roy et al. also found that although concerns over professionalism existed, there was not actually any concrete evidence of unprofessional behaviour when social media was implemented correctly. Cartledge et al. (2013) came to the same conclusion and even contacted the authors of the papers included in their study, of whom none could report any actual event of unprofessionalism. There may be however a certain amount of publication bias with editors only publishing articles with positive outcomes (Cartledge et al., 2013). Further quantitative studies are therefore needed to confirm or dispel the negative connotations linked to the use of social media within medical education. However, even if this is proved to be a drawback of using social media, it is better for students to have the opportunity to hone their professional judgement at medical school. Unprofessional behaviour at such an early stage of their medical career will be less consequential compared to when they are practicing doctors.

Other issues that arise with social media usage are the technical challenges. Firstly there is a discrepancy between the students themselves, with 91% of students aged 18-25 using Facebook, 78% of students aged 26-35 using it and only 6% of over 50s having a profile (Pander et al., 2014). This suggests that older students might not find social media as useful as their younger peers (Cheston et al., 2013). It is likely that a discrepancy also exists between the level of expertise of the faculty and the students as the staff have not grown up with social media at their fingertips (Pander et al., 2014). Faculty members are well placed to introduce students to using the various forms of social media at their disposal whilst maintaining a certain degree of professionalism. Many lecturers however do not themselves know how to use social media therefore forgoing the benefits that it could bring to their teaching. In addition, students do not want faculty members involved with their social media profiles (Pander et al., 2014). This makes it difficult for the lectures to fulfill their potential as teachers and as digital-professional role models.

**Future Development**

Cheston et al. (2013) write that technologies often evolve faster than the evidence demonstrating their effectiveness. Social media use within medical education is no exception. Whilst the opportunities and benefits of adopting social media into medical education seem to outweigh the cons, the majority of the evidence is descriptive (Cartledge et al., 2013; Pander et al., 2014; Roy et al., 2015). There is therefore a need for more rigorous quantitative studies to evaluate its true potential and place within the educational program.

The systematic reviews are also limited in part because the results of this topic are time dependent. The rate of use of social media within medical education is growing rapidly with studies being published on a regularly basis (Cartledge et al., 2013; Pander et al., 2014; Roy et al., 2015). This means that once the systematic reviews are available they soon become
outdated and fail to address the most current evidence. It is therefore important for regular systematic reviews to be conducted.

**Hypothesis**

This review will therefore look at the studies that have been published since the last systematic review was written, of which there are a number of quantitative studies. It is expected that this will add much needed evidence to whether social media should be included in the medical curriculum or not whilst also developing some of the themes that arose in the past five reviews. This review aims to create a questionnaire that will allow the exploration of student opinions and experiences of using academic social media platforms so that information can be gained on how best to use social media within the undergraduate medical curriculum. Ideally, this questionnaire will be dispensed to medical student cohorts at other universities with the aim of creating a larger, more diverse collection of quantitative data.

The research questions this questionnaire seeks to answer are:

- What role can social media play in the medical curriculum; which platforms are most effective and for what purposes?
- How beneficial is social media to teaching; is it equal to or more effective than traditional educational sources?
- What do students understand the benefits/disadvantages of academic social media platforms to be?

**Methods**

A systematic review was conducted following the Best Evidence Medical and Health Professional Education (BEME) protocol (Flannery, 2015) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009).

**Search Strategy**

Using the methods described by Cook and West (2012), two medical education researchers, the following databases were used: Medline, Cochrane, PsychINFO, ERIC (Educational Resources Information Centre [for education studies]) and Scopus. The search was conducted from 1st January 2014 to 12th January 2017. 2014 was chosen as a cut off date because it represented the year that the latest systematic review was accepted by its publisher (Academic Psychiatry) (Roy et al., 2015). Papers from this point therefore would not have yet been examined. Any paper that had already been reviewed was excluded from this study after cross-referencing the bibliographies from the five existing systematic reviews.

The search resulted in a total of 1056 studies from the databases as follows:

- PubMed (Medline): 294 studies
- Cochrane: 96 studies
- PsychINFO: 9 studies
- ERIC: 99 studies
- Scopus: 566 studies

In addition to this, the reference lists of randomly selected articles were hand-searched to identify additional articles; this would continue until no additional articles were identified. The first paper was examined with no further articles meeting the inclusion criteria (Rodríguez-González et al., 2016). Three more bibliographies were analysed in case the first was an exception but again no pertinent studies were identified (Brisson et al., 2015; Ekarattanawong et al., 2015; Sood, 2015). The search resulted in a total of 1056 studies from the databases as follows:
Inclusion & Exclusion Criteria

All article types were included in this review including both peer reviewed and non-peer reviewed research. It was felt that many pieces of grey literature were relevant for the purpose of this study and could add to evidence-based decisions as long as their limitations were recognised (Cook & West, 2012).

Articles were excluded for the following reasons:

1. Postgraduate study - The focus of this review was undergraduate medical studies. This meant that all studies conducted post-medical school were excluded.

2. Non-medical education - All papers that looked at the use of social media in non-medical education were excluded.

3. Date - As mentioned previously 1st January 2014 was chosen as a cut off point.

To minimise bias a second author, Catherine Hennessy (CH), checked the terms of exclusion and agreed with the parameters for all included article.

Study Selection

The study selection was conducted in two stages. Firstly, articles were excluded after screening the article’s title and abstract. If there was any ambiguity the paper was reviewed in the second stage. During the second stage papers were read in their entirety before being excluded. The resulting process can be seen in the flow diagram (Figure 1). The template was taken from the PRISMA website with its eligibility having been reviewed multiple times (Moher et al., 2009).

Data Extraction

Thematic analysis was conducted with ‘Mendeley’ software (Mendely Ldt., 2016). Important information was highlighted and coded then grouped together in themes. Information was put into tabulated form along with the study’s limitations and conclusions (Appendix 1, 2 & 3). This task was undertaken by the primary author (WW) and verified by the second author (CH). Both qualitative and quantitative studies were included.

Questionnaire creation and validation

After reviewing the literature a questionnaire was constructed following Boynton’s (2004) guidelines (Appendix 4). The aim was to create a questionnaire that could be used universally to generate a large archive of quantitative data. The questionnaire was reviewed and validated in two separate focus groups by a total of eight students. The questionnaire itself was divided into four separate sections, each one tailored to answer specific questions.

Part 1 was created to gage how useful social media was compared to traditional learning materials such as lecture slides, texts books and core reading lists. Part 2 focused on which social media platforms were used, how frequently and whether this was for social, educational or professional purposes. Part 2 also established which features of social media would be most useful if used within medical education. Part 3 addresses a limitation that occurred in a number of the included studies: professionalism. Finally, Part 4 was added as an open question at the end so that students could highlight any areas that might have been overlooked.

Results

Qualitative and Quantitative Studies

The initial database search resulted in 1056 papers. After duplicates were removed only 544 remained. The first exclusion phase removed 510 papers and the second phase removed 7. The result was 27 different papers of which 12 were qualitative and 15 were quantitative (Figure 1).

The remaining papers were analysed and the key information was put into table format. This included study design, data type, study limitations and conclusions (Appendix 1 & 2). The coded information was grouped into six themes based on the areas of impact that social media had within medical education (Table 1).

Questionnaire

The original questionnaire (Appendix 4) was created based on the themes identified over the course of this review. After it was designed eight Brighton and Sussex Medical School (BSMS) students completed the questionnaire. Four of them...
were in their first year of study whilst the other four were in their fifth year. Upon completion feedback was collected and appropriate changes were made to the questionnaire (Appendix 5).

Part 1 remained largely unchanged apart from ‘offline multimedia’ being replaced by ‘journals’. Originally ‘offline multimedia’ was supposed to represent journals, books and papers that could be accessed offline, at the university library for example. The participants of the focus group said however that this was not clear and that if they were going to access any information other than a textbook it would be an online journal.

In Part 2 a definition of social media was added as there was a discrepancy between what the participants believed social media to be and the actual definition. For example all eight members were unaware that Wikipedia and YouTube were social media platforms and this affected their response to question 1 of Part 2. These two sites were therefore added to the

![Flow diagram: Study selection and evaluation](image-url)

**Figure 1. Flow diagram: Study selection and evaluation**

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| Themes                          | Number of papers |
|---------------------------------|------------------|
| Community & Interactivity       | 15               |
| Communication & Feedback        | 15               |
| Learning theories               | 5                |
| Social media vs Traditional didactic lectures | 12              |
| Role of faculty                 | 11               |
| Professionalism                 | 15               |
definition. There was also some confusion over the acronym “SMS” as the majority of the participants thought this was referring to text messages also know as Short Message Service (SMS). Social media sites therefore became Social Media Platforms (SMP).

In Part 2, question 3 several comments were made on the need to have a time frame between ‘once a week’ and ‘once a day’. This was also evident with some participants circling the line between the two boxes. ‘Several times a week’ was therefore added to provide the detail needed. In question 4 of Part 2 the participants though that ‘Webinars’ should also be included, as they would find them useful.

In Part 3, two participants felt that value would be added to the study if the questionnaire asked which SMP they had a personal and private account on. An asterisk and question were added to the table. Finally, throughout the questionnaire the term ‘professional’ posed a problem. At undergraduate level it seems that education and profession are synonymous. This was also found to be the case in Usher et al.’s study (2014) with only a small proportion of final year students (11%) having a professional LinkedIn account. Due to the ambiguity it caused it was removed from the corresponding tables.

**Discussion**

The use of social media within medical education is in its infancy. Previous systematic reviews have found that it is a useful resource and can be beneficial when implemented correctly. Many of the studies however are still only descriptive and there is a need for quantitative data in order to justify social media’s place within the medical curriculum. Through an examination of the most up to date literature this systematic review aimed to evaluate three of the main social media platforms: Facebook, Twitter and YouTube and how they have been integrated into the medical curriculum. Secondly, the six recognised themes (Table 1) were analysed in order to identify which questions remain to be answered and what areas need to be developed further in order for social media to become a credible resource within medical education. The information gained from this process was amalgamated to create a valid questionnaire intended to produce future quantitative data.

**Platforms used**

**Facebook**

Various social media platforms were used across the studies. Facebook was the most popular as it was used in nine studies followed by Twitter (7 studies), YouTube (5 studies), wikis (2 studies) and blogs (1 study). Of the nine Facebook studies four of them were quantitative with a combined cohort of 1556 medical students from over 12 different countries (Amgad and AlFaar, 2014; Ekarattanawong et al., 2015; Jaffar, 2014; Usher et al., 2014).

A large portion of the reviewed student cohorts use Facebook. This ranged from 78.8% to 93% of students (Amgad and AlFaar, 2014; Usher et al., 2014). In Jaffar’s study (2014) he shows an increase of usage over the course of one year. In 2012, 86% of students were actively using social media, in 2013 this rose to 92%. Amongst users however there were found to be some discrepancies between age groups. Usher et al. (2014) found that whilst 93% of first year students used Facebook, the majority of these were aged 16-25 (97%) with only 74% of students aged 45 or over accessing the site. Facebook’s influence is steadily growing with most students actively using the site. Despite the potential lack of familiarity amongst older students Facebook has the potential to be a useful tool.

Facebook was used in a number of ways. Jaffar (2014) created a ‘Human Anatomy Education Page’ (HAE). The most popular feature of this page was pictures of anatomical structures that were uploaded and that students then had to identify and label. 96% of students used this feature. The second most used item (94%) was multiple-choice questions followed by explanatory comments (88%), videos and video links (87%) and links to other online anatomy resources (82%). Ekarattanawong et al. (2015) and Amgad and AlFaar (2014) adopted a different approach. They used Facebook more as a means of communication that allowed them to keep in contact with students with updates on day-to-day requirements. Facebook is therefore a multifunctional tool that would allow educators and students alike to adapt to their own teaching and learning styles.

The results were unanimously positive. Jaffar (2014) found that 84% of medical students “agreed/strongly agreed that Facebook could be a suitable learning environment”. Amgad and AlFaar (2014) reported that 98.1% of students said that they would “recommend the use of social media” and that 96.2% agreed that the use of social media “made the course more intellectually stimulating than if it was based on conventional methods”. In similar fashion Ekarattanawong et al., (2015) found that the majority of students wanted social media to be integrated into their other modules.

More specifically, students found that social media made learning more interesting and challenging, whilst improving their self-confidence and understanding. It also allowed students to communicate with tutors and colleagues more openly.
and instantaneously (Jaffar, 2014; Sood, 2015). It can therefore be seen as a supplement to conventional teaching. Despite the mild heterogeneity in terms of Facebook use between age groups it is still widely used. As most students use it for socialising/entertainment this means that its transition into academia should be straightforward (Sood, 2015). This aligns with Malcolm Knowles’ ‘andragogy’ theory that states that adults learn more efficiently when they integrate familiar tools into their learning (Barry et al., 2015) suggesting that by introducing social media into the curriculum, learning should become more effective for students.

Whilst the results of these studies are promising, there exist several limitations. The main issues center around the format of the four quantitative cross-sectional studies (Amgad and AlFaar, 2014; Ekarattanawong et al., 2015; Jaffar, 2014; Usher et al., 2014). Several of them are prone to sample bias. Usher et al.’s (2014) cohort was 82% female, Jaffar’s (2014) was made up from a small group of students from the United Arab Emirates and Sood (2015) only looked at the opinion of one educator. This reduces generalizability. However, the same outcomes are being noted across the different studies so by pooling the results together the sample bias is reduced.

As most of these studies are explorative in nature they lack methodical rigour. The qualitative studies are often limited to one or two authors and therefore prone to researcher subjectivity whilst the quantitative studies are prone to response bias (Amgad and AlFaar, 2014; Gaglani and Haynes, 2014; Guarino et al., 2014; Madanick, 2015 and Usher et al., 2014). This is generally because the test subjects are volunteers and are computer literate. The results of the self-reported questionnaires are therefore more likely to portray social media in a positive light. For more rigorous results, future studies will need a more diversely selected cohort and ideally a control group to compare social media and traditional teaching methods.

**Twitter**

Seven of the included studies looked at Twitter and how it can be used within medical education. When Junco et al. (2011) integrated it into the curriculum they found that students were more engaged in the subject and achieved better exam results. This was thought to be because of the improved communication between the students themselves and staff. Webb et al. (2015) also found that the students that participated in the weekly Twitter quiz had improved exam results compared to those that did not. To our knowledge this is the only study that compared Twitter users with a control group. This is therefore a more rigorous study and adds weight to the argument in favor of incorporating social media into the medical curriculum.

Hennessy et al. (2016) however found a negligible positive correlation between Twitter use and grade results, despite 91% of the cohort using the Twitter hashtag. Yet they found that it increased student engagement during the anatomy course as well as creating a support network that helped reduce anxiety and stress. As it is a microblogging platform, it is well suited to ongoing public dialogue. Hennessy et al.’s hashtag created an online, informal community where students could share their thoughts and concerns, which in turn encouraged learning. This was also found to be the case in Madanick (2015) and Chretien et al.’s studies (2015) as students used it for networking opportunities, mentorship and learning.

It must be noted that the regular input of teachers was needed to successfully manage the Twitter account as a support tool (Hennessy et al., 2016). This could be seen as a disadvantage as staff would have to work extra hours. Alternatively, the time invested by the staff in Twitter could be offset against the time it would take to individually respond to student’s emails, as Twitter offers a ‘one-to-many communication channel’ (McArthur and Bostedo-Conway, 2012). Hennessy et al. (2016) also noted that the mean student ratings for the anatomy workshops had significantly increased since the introduction of the anatomy Twitter account and specific neuroanatomical hashtag suggesting a positive correlation between social media use and student satisfaction. However, the mean was also found to have increased over the two years preceding Twitter’s inclusion in the curriculum. It is therefore difficult to note accurately if Twitter led to the significant increase or if it was just a continuation of an existing trend.

Usher et al. (2013) compared Twitter and Facebook use and concluded that Twitter use is comparatively low. Only 14% of first year students and 16% of final year students used Twitter. In terms of global use, by the end of 2013 Facebook had 987 million more users than Twitter yet, over the course of the last three years they have however had the same growth of 150% (Statista, 2016). It therefore remains a substantial element of social media and should not be ignored. It is also widely used by healthcare professionals to track worldwide conversations in order to gain a better understanding and wider perspective on chosen topics (Roupert and Mistrat, 2015; Widmer et al., 2016; Wilson et al., 2015). O’Kelly et al. (2015) reported that students found the Twitter account ‘@surggrandrounds’ extremely useful. It made the information from their surgical teaching more accessible and the students wanted Twitter to feature in their other modules.
Most studies found that Twitter and social media in general are a welcome addition to traditional lecture based learning. It remains to be seen how useful it can potentially be and how it fares in comparison to traditional teaching methods. Part 1 of the questionnaire was tailored to address this topic (Appendix 5). Indeed it asks how useful students find various learning materials and quantifies the answer. With the resulting information social media will be comparable to other methods such as textbooks and lecture slides. Webb et al. (2015) concluded that Twitter is not a replacement for existing aspects of medical education but that it should be considered as a useful adjunct to the curriculum as students found it added to their education. There were however questions raised over its utility given that each Tweet can only be 140 characters long (Hennessy et al., 2016). Moreover, there remains some concern that this short style of communication will encourage poor writing habits and grammar among students (Grosseck and Holotescu, 2008). However, this issue was not reported in any of the included studies and it can be argued that character limit allows the information to be concise and therefore more beneficial.

As with Facebook, there were many limitations surrounding these early studies. Again responder bias and sample bias are the main issues, for example Chretien et al.’s study (2015) consisted of Twitter ‘superusers’. This meant that Chretien et al. chose students that already had Twitter accounts and more specifically students that used it to access professional content. Although, due to the ‘superuser’s’ expertise, this did show how Twitter could be used to its full potential, it is not representative of what the average medical student would do. These users would also have been biased during their interviews as they inevitably would have responded in Twitter’s favour. Usher et al. (2014) and Webb et al. (2015) also had cohorts made up of proficient Twitter users which could have skewed results. In addition to this, the majority of the studies failed to include a control group and therefore could not compare social media use with other teaching methods (Amgad and AlFaar’s, 2014).

**YouTube**

YouTube was also documented as being an important learning resource (Amgad and AlFaar, 2014; Barry et al., 2016; Madanick, 2015; Rabee et al., 2015). The video format meant that students were able to view and visualise concepts therefore heightening their understanding. This was particularly important for subjects such as anatomy (Barry et al., 2016). In Jafra’s 2012 study he found that 92% of students “agreed” or “strongly agreed” that the Human Anatomy Education channel on YouTube was important to their understanding of the subject. Barry et al., (2016) found that 78% of participants used YouTube as their primary source of information for anatomy with only 29% looking at recommended textbooks. With such a large proportion of students using YouTube it is important that lecturers adopt this tool.

The rise in popularity of YouTube, and by extension social media, is due to the speed of access of information. The majority of students at undergraduate level are Millennials that operate at ‘twitch speed’ (Prensky, 2004). They expect responses and feedback instantaneously. This, paired with the three dimensional qualities of YouTube, make it an invaluable tool for learning anatomy (Barry et al., 2016). The major issue with YouTube is that the material the students are viewing has not been validated. Inevitably there will be students learning information that is incorrect or misleading.

This is an important concern throughout the literature and not unique to YouTube (Guarino et al., 2014; Sherbino and Frank, 2014; Sherbino, 2015). Students must understand that not all resources are equal. Lecturers therefore have a duty to warn students about these dangers. Ideally, staff could produce their own videos or at least evaluate and share the most pertinent online material (Madanick, 2015 and Rabee, 2015). Chretien et al. (2015) suggest that students should be taught how to critically evaluate the information that they are accessing via social media. If not, they risk leading themselves and others astray (Rodríguez-González et al., 2015).

This review chose to focus on Facebook, Twitter and YouTube as they featured in the majority of the included studies. As mentioned earlier these sites are extremely popular among students socially, but that does not mean that they are the best educational resources. Other social media platforms may be just as beneficial but have been overlooked in research due to the popularity of Facebook and Twitter. Part 2 question 2 of the questionnaire (Appendix 5) therefore addresses this issue. Six other social media platforms are put forward alongside Facebook, Twitter and YouTube in order to see if they are also used either socially or educationally. The following section of the questionnaire then allows students to expand on how they use these platforms with question 3 gauging the frequency of use.

Various methods have been used across different platforms to try and integrate social media into the medical curriculum. The results and feedback from the students has been positive despite the heterogeneity of the techniques. Part 2 question 4 of the questionnaire (Appendix 5) was therefore created to generate quantitative data on which features of social media would be most beneficial to students. This information will hopefully give insight into the areas of social media that will be most valuable to students and consequently adopted by educators.
Community & Interactivity
Social media helps bring groups of people together, both students and faculty, leading to a stronger sense of community, which in turns increases interactivity, productivity and confidence (Amgad and AlFaar, 2014; Chretien et al., 2015; Duke et al., 2015; Hennessy et al., 2016; Jaffar, 2014 and Sherbino, 2015).

Chretien et al. (2015), Hennessy et al. (2016) and Sherbino’s (2015) papers all elucidate this sense of community and its importance. Chretien et al. and Hennessy et al. show how through Twitter medical students are able to bond by supporting one another through the rigours of medical school. Faculty were also found to provide guidance and encouragement through Twitter. Communities are no longer bound by geography as students also followed groups of like-minded people outside of their medical schools (Hillman and Sherbino, 2015). These virtual communities serve as sources of inspiration. Chretien et al. (2015) recorded one student’s wish to pursue a primary care specialty following the information and experiences she’d gained from one online community.

The most striking example of virtual communities is Free Open Access Meducation (FOAM) (Hillman and Sherbino, 2015; Madanick, 2015; Sherbino and Frank, 2014). FOAM is a collection of resources and tools as well as a community and ethos. Twitter has been instrumental to its success and development. It is a symbol of what social media can achieve within medical education. Its goal is to distribute information and resources around the world with its philosophy derived from the Hippocratic oath: ‘[…] to teach them this art - if they desire it - without fee and covenant’ (Nickson and Cadogan, 2014).

The nature of social media and therefore FOAM allows for locally produced information to be distributed around the globe. One emergency medicine blog featuring on FOAM had as much as 12 million unique visits a year (Cadogan et al., 2014). Sherbino (2015) noted that this ‘virtual participation’ helped to enrich the wider discussion of a topic. Free access to such large pools of educational resources can only serve to benefit students and educators alike. Webb et al. (2014) showed that it helped improve student grades. It can therefore be argued that instantly accessible learning resources like FOAM should complement the medical curriculum.

Despite this success there is some negativity surrounding FOAM. This is because the information is not peer reviewed like traditional medical journals and could therefore potentially be misleading or false. However, given the size of the FOAM community articles are, in their own way, reviewed. As all publications are free they are open to debate and discussion by the entire medical community. For the most viewed resources the scrutiny to which they are subjected could arguably be more rigorous than the traditional peer-review process. Unfortunately this is not the case for all information and students must be selective in what sources they chose to view (Parsi and Elster, 2015).

Social media has revolutionised the way we produce and distribute information. It should therefore start to find its place alongside journals and textbooks as an educational tool (Nickson and Cadogan, 2014). As well as an increase in recourses social media offers greater interactivity, a greater understanding of learning responsibility and a means of continuous feedback about one’s own progress in comparison to peers. Social media serves to inspire and engage students as well as improving understanding and widening their perspectives (Amgad and AlFaar, 2014; Usher et al., 2014).

Communication & Feedback
With community comes communication. Social media allows for faster communication and feedback from peers but more importantly from lecturers allowing students to act in a more timely and productive fashion (Ekarattanawong et al., 2015; Usher et al., 2104).

Ekarattanawong et al. (2015) explore this further in their study. They show that social media enhances communication with lecturers. This is because they can speak directly to a staff member whereas before they had to go through a class representative. The speed of response has also increased. It was found that questions answered by means of social media were more valued than an in class answer. Controversially, Ekarattanawong et al. (2015) found that communication between students themselves was poor. This could be because the use of a Facebook page is not as suited to open discussions as other forms of social media. The authors suggest that a ‘closed group’ would yield better participation.

The speed of feedback was also noted by Hennessy et al. (2016) to be a strength of social media and in particular Twitter. Several students reported that it helped over the revision period as feedback was rapid and concise due to the 140-character limit. In addition the hashtag being used was public and therefore available to all students. This meant students were able to read each others questions and more importantly the feedback they received from staff. This was noted by most students to be a vast improvement to emailing lecturers. However, several students felt that on occasion the
140-characters was not enough for a detailed explanation and stressed that the option to email should still be available. Again, this is a case of how social media can complement existing tools to improve the medical curriculum.

Hennessy et al. (2016) also noted that the face-to-face relationship between student and lecturers was improved. Students felt that because they had spoken to staff via Twitter that they were then more approachable in the lab. This shows that a relationship built online can be transferred to the classroom. Conversely some students found that they did not know how to address their lecturers via Twitter. Therefore if social media is chosen to be part of the curriculum then lecturers must first set out guidelines so students know how to utilise this new tool.

Learning Theories

There are two key learning theories that underpin the use of social media within medical education: Connectivism and Constructivism (Davis et al., 2015; Flynn et al., 2015; Hennessy et al., 2016; Mi and Gould, 2014). However, a large number of educators are unaware of their importance despite their relevance. Constructivism is an umbrella term that groups together a number of learning theories that have become more prominent since the birth of social media. They are centred on the fact that students subjectively construct knowledge themselves. Flynn et al., (2015) identified the Social Development Theory and Communities of Practice to be the most important Constructivism theories linked to social media whilst Hennessy et al., (2016) highlight the importance of a Zone of Proximal development (Table 2).

With the integration of social media into medical education, learning has become a more social process because it is user-generated and collaborative. Students are able to build their own knowledge from people with more expertise than themselves. This traditionally is the lecturer but can also include peers. It is thought that this active process of understanding through interactions with others is vital for the students’ development and learning (Flynn et al., 2015; Hennessy et al., 2016). This could be the reason that exam results were better in Junco et al. (2011) and Webb et al.’s (2015) studies. However this remains a hypothesis until it becomes the subject of its own study.

Connectivism mirrors the Constructivist theory for learning but focuses specifically on using social media as an educational tool and in doing so enhances the experience. It is easier for lecturers to connect learners to one another via social media, which allows for an active learning environment. Students are more able to share information, ideas and feedback especially outside of the classroom. Via social media they are also able to contact experts and are therefore not limited to the resources at their own medical school (Hillman and Sherbino, 2015). Lecturers that use social media should have an understanding of Connectivism and Constructivism. This will help them plan effective learning events and assessment practices which will ultimately enhance the students’ learning (Flynn et al., 2015).

Role of Faculty

Social media is a relatively new tool and can seem alien to faculty members. Barry et al., (2016) highlights that 63% of surveyed educators did not want to use Facebook as a teaching tool whilst 85% had had no formal training. This is problematic as lecturers need to be familiar with what the students are doing and in certain cases even teaching them how to best use social media. Several of the studies proposed how lecturers could achieve this as well as analysing their interactions with the students (Duke et al., 2014; Flynn et al., 2015; Hennessy et al., 2016; Kind et al. 2014).

Table 2. Definitions of Social Development Theory, Communities of Practice and Zone of Proximal development

| Social development theory | Social interaction is fundamental to learning. Learning occurs in the zone of proximal development—the area between needed instructor/peer guidance and the learner’s ability to function independently |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Communities of practice    | A process of social learning that occurs when people with a common interest collaborate sharing ideas, strategies, determining solutions and building innovations                                                                                     |
| Zone of Proximal development | Cognitive structures that are still in development, can only fully mature by collaborating with others                                                                                                                                 |

Students are starting to use social media to supplement their learning and some even use it as a primary source of information (Usher et al., 2014). It is therefore important for faculty members to engage with these tools so that they can ensure that the viewed material is both correct and fit for purpose or even highlight high-quality resources to learners (Barry et al., 2016; Walji and Stanbrook, 2015). Lecturers could go a step further and produce their own material. Raikos and Waidyasekara (2014) reported that a faculty-produced video was found to be extremely useful by 92% of surveyed students. This proves that institute led material has the potential to be a high yielding learning source and that faculty should be encouraged to prepare their own material online.

Another important aspect of lecturers being on social media is that they can share their material with a larger audience. They can then get feedback from students and teachers worldwide and subsequently improve their content (Madanick, 2015; Walji and Stanbrook, 2015). They can also use the ‘insight’ tools offered by the various platforms that provide analytic data. Madanick (2015) uses YouTube as an example. Lecturers that have posted videos online can find out how many times they have been viewed, if the entirety of the clip has been watched and whether segments have been replayed. With this data they can then adjust their videos accordingly. If sections have been replayed for example this might suggest that the subject matter was more complex in nature and would benefit from a more in depth explanation. This type of feedback is quick and efficient and allows for improved teaching material.

This tool is not unique to YouTube and can also be found on Facebook and Twitter which allows the administrators to track page interactions and popularity (Ekarattanawong et al., 2015; Gaglani and Haynes, 2014; Hennessy et al., 2016; Jaffar, 2014). These activity measures however are limited to the administrator and their activity. For example Twitter Activity can only track the user’s tweets and not the tweets or comments made by others (Hennessy et al., 2016).

Hennessy et al. (2016) stress the importance of faculty involvement as without their input social media as an educational tool would not be effective. In their study members of staff maintained a Twitter account. For it to be useful they had to view it several times a day in order to answer the students’ questions. As mentioned previously this took less time than answering individual emails as the answers on Twitter were visible to the whole cohort.

For this to be achievable staff members may need to have some form of IT training as they are not as apt at social media use as students (Duke et al., 2014). Brisson et al.’s (2015) study focuses on the mismatch between lecturer and student. Whilst they believe that it is the lecturer’s role to teach students how best to use social media, they found that the staff members did not actually have the skill set to do so. If social media is misused then it can negatively impact the students learning due to disrupted workflow and the potential to distract (Flynn et al., 2015; Madanick, 2015). If social media is to be successfully integrated into medical education than this mismatch must be addressed. Faculty must be as at ease with social media as the students (Jaffar, 2014). These points are raised in Kind et al.’s (2014) study which is a compilation of twelve tips that help take educators through the process of using social media within medical education.

Flynn et al. (2015) outlined what lecturers can and should be achieving with social media usage. The study concluded that lecturers should have an understanding of Connectivism and Constructivism so that they could provide the most effective education. To do this they should provide scaffolding to learners with greater support at the outset of learning. This can be achieved by sharing links to resources via Twitter or maintaining the module Facebook page. The lecturer should then take a step back to allow the learner to develop their own knowledge and expertise. They could do so by testing the students’ knowledge with online quizzes, multiple choice questions or polls. These are all achievable via Twitter and Facebook.

There exist concerns over mature students and staff’s aptitude at using social media. The questionnaire was tailored to gather information from students but insight could be gained if lecturers also completed it. The demographic section paired with Part 2 question 1 would indicate how apt people are at using social media according to their age. Lecturers could also complete questions 2 and 3 of Part 2 which would indicate which platforms they use, if any, and how often they use them. Question 4 would help gather information on what the educators think would work best in terms of teaching and this could then be compared to the responses given by the students.

**Professionalism**

There are many positives surrounding the use of social media within medical education however there is a lot of concern over professionalism (Chretien et al., 2015; Gooi et al., 2014; Hennessy et al., 2016; Jaffar, 2014; Parsi and Elster, 2015; Raikos and Waidyasekara, 2014; Shandzas et al., 2014; Walji and Stanbrook, 2015). This includes conflicts of interest, privacy and confidentiality violations and inappropriate relationships with patients. The online environment is a new domain that is not yet well structured or regulated. The potential for social media use to backfire is ever present. As much as 60% of medical schools in the USA have reported incidents of unprofessional behaviour and more than half of students...
have described unprofessional behaviour by their colleagues on Facebook (Brisson et al. 2015). There exist documented cases of sanctions and expulsions from medical school (Chretien et al., 2009; Greysen et al., 2012).

In order for the patient-health care professional relationship to succeed privacy and confidentiality must be maintained, since preserving a patient’s trust is fundamental to their care (Parsi and Elster, 2015). Privacy and confidentiality differ slightly in their terminology. Privacy is defined by the individual; they can divulge or withhold whatever information they choose. It is patient controlled. Confidentiality on the other hand is controlled by the professional. Information has been volunteered by the patient and it is the healthcare professional’s role to protect it. It is important to differentiate these two words as both are affected by social media use but in different ways. Medical students may be lax with their own privacy, at their own cost, but cannot afford to compromise a patient’s confidentiality (Sood, 2015).

There exist national guidelines as well as university guidelines on how to behave online. These include points on safeguarding patient privacy, avoiding controversial material and “pausing before posting” (BMA, 2011; Davis, 2015; Hillman and Sherbino, 2015; Parsi and Elster, 2015; Usher et al., 2014). This is in place so the students will reflect on the fact that they are posting in a public domain. However, students are not often aware of these guidelines or in some cases disagree with them. In Chretien et al.’s study (2015) the Twitter ‘superusers’ disregarded the idea of having separate professional and personal accounts. They felt that the personal aspect added authenticity to their account. This was especially important for them when conversing with patients. This however seems to be an irregularity.

Most health care professionals want to keep their personal and private lives detached and this is mirrored in the guidelines (O’Kelly et al., 2015; Hillman and Sherbino, 2015; Parsi and Elster, 2015). Unfortunately with most social media platforms it is often difficult to have two separate accounts. This shows a discrepancy between the guidelines and what is actually achievable. Due to the fact that social media is a relatively new area, there seems to be a lack of understanding from the governing bodies. On top of this, due to the ever-changing nature of social media, any relevant guidelines fast become outdated.

Chretien et al. (2015) conclude that the participants used Twitter with thoughtfulness and purpose. Their behavior was exemplary and any concerns about unprofessional behaviour were unfounded in this cohort. However this study did include Twitter ‘superusers’ so their behavior may not be representative of the average medical student as the ‘superusers’ were found to be more aware and conscientious of their actions.

For the general student then it is important for educators to integrate ethics and professionalism into their teaching as two thirds of students had noticed unprofessional material on their peers’ social media profiles (Brisson et al., 2015). These were often not acted upon despite conflicting with the guidelines. This is thought to be because the current net generation sees their social media profiles as an extension of themselves and confronting someone about their online behavior may feel like a personal affront rather than a professional duty. There must be some form of specific teaching then to combat this irregularity (Walji and Stanbrook, 2015). Lecturers should reiterate the guidelines in order to prevent harm to students and patients alike. Greysen et al. suggest that “first, do no harm” is relevant to social media use and should be at the forefront of students’ minds.

It is important for lecturers to prepare students for their professional lives; it is one of the central missions of medical education (Ushere et al., 2014). The Liaison Committee on Medical Education (LCME) in the USA point to core professional qualities such as compassion and integrity that must be developed during a student’s time at medical school (Duke et al., 2014). Social media can be used as a tool for training professionalism (Duke et al., 2014; Hennessy et al., 2016). This can be achieved by creating small, faculty-facilitated groups. Duke et al.’s study (2014) used social media as a means of communication for the members of these groups. The students adapted quickly to this platform where they could examine, process and explore interactions that they had seen between patients and physicians. Through this they were able to increase their levels of self-reflection and preserve levels of empathy and compassion. These traits have generally been seen to decline in students entering their third year of study as well as an increase in stress and burnout (Duke et al., 2014).

There is concern over professionalism, especially from the faculty. Part 3 of the questionnaire was created to assess how students felt about this subject. This topic was one of the main barriers to social media use yet the literature does not highlight whether or not this was an issue for students themselves. Part 3 therefore is tailored to generate quantitative data on whether students know about the existing guidelines, if they have read them and if they are concerned about using social media.
Limitations
This systematic review has a number of limitations. As social media is still a relatively new technology its growth is exponential and studies are being conducted constantly. This means that with the publication of new papers this review will soon become outdated. Additionally the decision was also made to include non peer-reviewed articles. These are more prone to bias and not as rigorous as other studies but they still added value to this review. Also due to the heterogeneous nature of the articles it was difficult to synthesise the results and implications. It was not possible to do a meta-analysis or subgroup-comparison. Although there was some quantitative data, this was limited and the majority of the information was qualitative.

As with most systematic reviews there is an element of publication bias favouring the benefits of social media rather than the negative results. At times a second author was used to minimise bias during the data extraction but this was only in the form of a review once the process had taken place. Therefore the selection bias was not completely eliminated.

Conclusion
Social media offers a number of innovative ways to facilitate and enhance student learning. Facebook and Twitter seem to be the most popular social media platforms. Through these, lecturers can answer questions more efficiently and post relevant learning material. They can also help test students’ knowledge with multiple choice questions, pictures and diagrams. Through an understanding of Connectivism, lecturers can use social media to complement traditional learning technics and enhance their students’ education.

Social media helps bring students and staff together and can create virtual communities. As well as gaining information and valuable experience through these, they have also been found to reduce stress and anxiety all whilst maintaining levels of empathy. Increased communication also allows for faster feedback that was found in some cases to be more valuable than in class answers. Ultimately, several studies found that social media improved exam results with many students actively saying that they wanted social media to be an integral part of the medical curriculum. There is therefore a need for large scale quantitative studies so that social medias place within medical education can be verified. The questionnaire attached to this study was validated by a focus group so that it could be used worldwide to try and build quantitative evidence either in favor or against the use of social media within medical education and answer three main questions:

- What role can social media play in the medical curriculum; which platforms are most effective and for what purposes?
- How beneficial is social media to teaching; is it equal or more effective than traditional educational sources?
- What do students understand the benefits/disadvantages of academic social media platforms to be?

Notes On Contributors
William Whyte is in his 4th year of medicine at Brighton and Sussex Medical School. In 2016 he completed a BSc (Hons) in Anatomy, Developmental & Human Biology. Throughout his studies he has had a keen interest in anatomy and medical education. This lead to his partnership with Catherine Hennessy and their subsequent systematic review on social media use within the medical curriculum.

Catherine Hennessy completed a BSc (Hons) in Exercise and Sport Rehabilitation in 2006 after which she spent five years working privately in the sports injury field in Ireland. In 2011 Catherine moved to Edinburgh to work with the military as a rehabilitation therapist before deciding to change career paths and to university. In 2013, she graduated with a MSc in Human Anatomy which allowed her to remain at the University of Edinburgh as an Anatomy Teaching Assistant. Catherine took up a new Anatomy Teaching Fellow position at Brighton Sussex Medical School in 2015 where she is investigating how social media (and in particular Twitter) can be used to enhance the student experience in medical education.

Declarations
The author has declared that there are no conflicts of interest.

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Appendices

Appendix 1: Table of the study titles, references as and a number of identification for appendix 2 & 3

| Table reference number | Title                                                                 | References                  |
|------------------------|----------------------------------------------------------------------|-----------------------------|
| 1                      | @StirH: the power of social media to transform medical education.    | Sherbino and Frank, 2014    |
| 2                      | A Digital Ethnography of Medical Students who Use Twitter for Professional Development. | Chretien et al., 2015       |
| 3                      | Advancing social media in medical education.                        | Wijl and Stanbrook, 2015    |
| 4                      | Anatomy education for the YouTube generation                        | Berry et al., 2015          |
| 5                      | Australian health professions student use of social media.          | Usher et al., 2014          |
| 6                      | Automatic extraction and identification of users’ responses in Facebook medical quizzes. | Rodríguez-González et al., 2016 |
| 7                      | Defining a mismatch: differences in usage of social networking sites between medical students and the faculty who teach them. | Brissone et al., 2015       |
| 8                      | Education Becomes Social: The Intersection of Social Media and Medical Education. | Malani, 2015                |
| 9                      | Effect of a Novel Engagement Strategy Using Twitter on Test Performance. | Webb et al., 2015           |
| 10                     | Exploring the use of a Facebook page in anatomy education            | Jaffar, 2013                |
| 11                     | How useful is YouTube in learning heart anatomy?                    | Ralkos and Waidyasekara, 2013|
| 12                     | Integrating web 2.0 into clinical research education in a developing country. | Amsgad and Alfajar, 2014   |
| 13                     | Internet-based versus traditional teaching and learning methods.     | Quarto et al., 2014          |
| 14                     | Learning theory and its application to the use of social media in medical education. | Flynn et al., 2015           |
| 15                     | Perception of social networking benefits in the support of a PBL module according to students' performance levels. | Ekasatanaawong et al., 2015 |
| 16                     | Preserving third year medical students' empathy and enhancing self-reflection using small group 'virtual hangout' technology. | Duke et al., 2014             |
| 17                     | Social media and anatomy education: Using twitter to enhance the student learning experience in anatomy | Hennessy et al., 2016        |
| 18                     | Social media in medical education: a new pedagogical paradigm?       | Hillman and Sherbino, 2015  |
| 19                     | Teaching medical students social media: must or bust.                 | Gooi et al., 2014            |
| 20                     | The Social Media Summit in Health Professions Education.             | Sherbino, 2015              |
| 21                     | Using Facebook for medical education: Will students respond?         | Sood, 2015                   |
| 22                     | Using Social Media to Increase Accessibility to Online Teaching Resources. | O’Keeley et al., 2015       |
| 23                     | What can medical education learn from Facebook and Netflix?          | Gagliani and Haynes, 2014   |
| 24                     | Why Can’t We Be Friends? A Case-Based Analysis of Ethical Issues with Social Media in Health Care. | Parsi and Elster, 2015       |
| 25                     | Why tomorrow’s doctors need to go.com.                              | Shamdas et al., 2014        |
| 26                     | Wiki technology enhanced group project to promote active learning in a neuroscience course for first year medical students: an exploratory study. | Mi and Gould, 2014           |
| 27                     | YouTube in medical education: a student’s perspective.               | Rubbe et al., 2015           |

Appendix 2: Study design, data type and the main themes present in the 27 chosen studies.

| Table reference number | Study design                  | Data type | Social media platforms | Community & connectedness | Communication & Feedback | Learning theory | Social media vs Traditional didactic lectures | Rule of faculty | Professionalism |
|------------------------|-------------------------------|-----------|------------------------|--------------------------|--------------------------|-----------------|-----------------------------------------------|----------------|----------------|
## Appendix 3. Study limitations and conclusions of the 27 chosen studies.

| Table reference number | Study Limitations | Conclusion |
|-------------------------|-------------------|------------|
| 1                       | Methodological rigor | "Opportunities for learning can extend to a network that spans the world" |
|                         | Sample bias       | "Twitter can serve as a professional tool that supplements traditional education" |
| 2                       | Methodological rigor | "The use of social media holds great value as a teaching and learning tool in medical education, […]" |
|                         | Sample bias       | " […] given the fast pace of change in information and communication technologies, decisions to engage students via social media should be considered regardless of the specific platform." |
| 3                       | Sample bias       | "Students would benefit from training on appropriate use of SNS. […] Differences in usage between students and faculty raise questions if faculty are well suited to provide this training." |
| 4                       | Methodological rigor | "If not used correctly, social media can be distracting to workflow, pose threats to a faculty member’s professional image, and cause a message to lose its intended meaning through a different context." |
|                         | Sample bias       | "While social media will never replace traditional medical education, innovations using social media can help teach or assess learners in some of the competencies with which educators often struggle" |
| 5                       | Sample bias       | "It is unlikely for social media to replace lecture in medical curriculums; however, there is a reasonable role for social media as an adjunct to traditional medical education." |
| 6                       | Sample bias       | "A wider educational use of Facebook should be adopted not only because students are embracing its use, but for its inherent potentials in boosting learning." |
| 7                       | Retrospective study bias | "Students should be selective when looking on public video databases as it can prove challenging, time consuming, and the anatomical information may be misleading due to absence of content review. Anatomists and institutions are encouraged to prepare and endorse good quality material and make them available online for the students." |
| 8                       | Methodological rigor | "Students’ feedback was positive and supported the integration of Web 2.0 tools in academic courses and modules. Google Drive, Facebook, and Dropbox were found to be most useful." |
|                         | Language barrier  | "The Internet represented an important aid to support students’ learning needs, but textbooks are still their resource of choice." |
| 9                       | Sample bias       | "The results of the workshop were achieved by consensus, not a formal quantitative or qualitative analysis." |
| 10                      | Sample bias       | "It is recommended that formal education (faculty development) around learning theory would further enhance the use of social media in medical education." |
| 11                      | Retrospective study bias | "The Facebook “closed group” with a good protective system may be an interesting option to enhance effectiveness in integrated PBL-styled courses" |
| 12                      | Twitter activity tool | "A negligible correlation was found between student examination scores and their viewing frequency of the videos however, no correlation was found between examination scores and contribution frequency. Despite this, Twitter facilitated communication, relieved anxiety and raised morale, which was valued highly by students and aided engagement with anatomists" |
| 13                      | Twitter activity tool | "Clinician educators should facilitate the transition of social media in healthcare into a valid, recognised element of professional practice" |
| 14                      | Methodological rigor | "The use of social media holds great value as a teaching and learning tool in medical education, by including students in the creation of their own knowledge and by facilitating engagement, self-reflection and active learning." |
| 15                      | Sample bias       | "Virtual participation enriched the wider discussion of a topic" |
| 16                      | Time (same time) | "It would appear logical to use the power of this medium (social media). The quiz questions tap only a fraction of the power." |
| 17                      | Time (same time) | "The novel use of social media is a useful adjunctive educational tool in accessing an online repository of SGR presentations" |
| 18                      | Methodological rigor | "Although promising, these approaches are not perfect and thus may be most beneficial when combined with human insight so that learners are provided with relevant and specific resources." |
| 19                      | Methodological rigor | "As healthcare professionals, we all need to accept, adapt, and amend policies, practices, and professional obligations to use social media with good outcomes and avoid the bad or even the ugly" |
| 20                      | Methodological rigor | "we are seeing a need for medical students and trainee doctors to “market themselves” online. We feel medical schools need to adapt to give their students a head start on creating their digital persona" |
| 21                      | Assumption bias   | "Given its ease of use and facilitation of collaborative learning and authorship (writing, editing, and reviewing content), Google Sites or other wiki products may be leveraged as a potentially enriching learning and teaching tool to promote active learning in medical education or any educational setting." |
| 22                      | Researcher subjectivity | "I therefore believe that there is a necessity for increased recognition by medical institutes of these YouTube videos." |
| Appendix 3 cont. | Sample bias | "It is recommended that formal education (faculty development) around learning theory would further enhance the use of social media in medical education." |
| 14 | The results of the workshop were achieved by consensus, not a formal quantitative or qualitative analysis. | |
| 15 | Facebook "Insight tool" | "The Facebook "closed group" with a good protective system may be an interesting option to enhance effectiveness in integrated PBL-styled courses." |
| 16 | Sample bias Poor response rate | "Students benefit from peer groups and discussion in a safe environment, which may include the use of a virtual group video platform." |
| 17 | Twitter activity tool Time frame | "A negligible correlation was found between student examination scores and their viewing frequency of the hashtag however, no correlation was found between examination scores and contribution frequency. Despite this, Twitter facilitated communication, relieved anxiety and raised morale, which was valued highly by students and their engagement with peers." |
| 18 | Methodological rigor Researcher subjectivity External validity | "Clinicians educators should facilitate the transition of social media in healthcare into a valid, recognised element of professional practice" |
| 19 | Methodological rigor Researcher subjectivity External validity | "The use of social media holds great value as a teaching and learning tool in medical education, by including students in the creation of their own knowledge and by facilitating engagement, self-reflection and active learning." |
| 20 | Methodological rigor Researcher subjectivity External validity | "Virtual participation enriched the wider discussion of a topic." |
| 21 | Sample bias | "It would appear logical to use the power of this medium (social media). The quiz questions tap only a fraction of the power." |
| 22 | Time frame Sample bias | "The novel use of social media is a useful adjunctive educational tool in assessing an online repository of Scir presentations." |
| 23 | Methodological rigor Researcher subjectivity External validity | "Although promising, these approaches are not perfect and thus may be most beneficial when combined with human insight so that learners are provided with relevant and accurate resources." |
| 24 | Methodological rigor Researcher subjectivity External validity | "As health care professionals, we all need to accept, adapt, and amend policies, practices, and professional obligations to use social media with good outcomes and avoid the bad or even the ugly." |
| 25 | Methodological rigor Researcher subjectivity External validity | "We are seeing a need for medical students and trainee doctors to "market themselves" online. We feel medical schools need to adapt to give their students a head start on creating their digital persona." |
| 26 | Responder bias | "Given its ease of use and facilitation of collaborative learning and authorship (writing, editing, and reviewing content), Google Sites or other wiki products may be leveraged as a potentially enriching learning and teaching tool to promote active learning in medical education or any educational setting." |
| 27 | Methodological rigor Researcher subjectivity External validity | "I therefore believe that there is a necessity for increased recognition by medical institutes of these YouTube videos." |
Appendix 4: Questionnaire before the focus group

Social media use within medical education

The purpose of this survey is to evaluate what role social media can play in the medical curriculum, which platforms are most effective and how beneficial it can be. There is no obligation to complete this survey. Thank you for taking the time to complete this survey. By doing so you will imply consent for your responses to be used in research.

Demographic
Age: Gender: □ Male □ Female

Part 1: Review of learning tools

Instruction:
How useful do you find the different learning tools? Please circle the appropriate number in each row.

|                  | Not useful | Not very useful | Neutral | Somewhat useful | Very useful |
|------------------|------------|-----------------|---------|-----------------|-------------|
| Text books       | 1          | 2               | 3       | 4               | 5           |
| Lecture material | 1          | 2               | 3       | 4               | 5           |
| Offline multimedia | 1      | 2               | 3       | 4               | 5           |
| Social media sites | 1       | 2               | 3       | 4               | 5           |

Part 2: Social media sites (SMS)

Instruction:
1) Please circle the appropriate number below

| I feel comfortable using SMS for: | Strongly disagree | Disagree a little | Neither agree nor disagree | Agree a little | Agree strongly |
|-----------------------------------|-------------------|-------------------|---------------------------|----------------|---------------|
| Social purposes                   | 1                 | 2                 | 3                         | 4              | 5             |
| Educational purposes              | 1                 | 2                 | 3                         | 4              | 5             |
| Professional purposes             | 1                 | 2                 | 3                         | 4              | 5             |
2) Which social media platforms do you use and for what purpose? Tick the relevant boxes.

| Social | Educational | Professional |
|--------|-------------|--------------|
| Facebook |             |              |
| Twitter  |             |              |
| YouTube |             |              |
| Wikipedia |           |              |
| Blogs   |             |              |
| LinkedIn |            |              |
| Mendeley |            |              |
| Snapchat |             |              |
| Instagram |            |              |
| Other*  |             |              |

*If other, please indicate what platforms you use.

Please expand on how you use SMS for educational purposes eg. Closed discussion groups on Facebook

3a) Please circle the box which describes how often you use Facebook.

| For socialising     | Never | Once a month | Once a week | Once a day | > Once a day |
|---------------------|-------|--------------|-------------|------------|-------------|
| For educational use | Never | Once a week  | Once a day  |            | > Once a day |
| For professional use| Never | Once a week  | Once a day  |            | > Once a day |

3b) Please circle the box which describes how often you use Twitter.

| For socialising     | Never | Once a month | Once a week | Once a day | > Once a day |
|---------------------|-------|--------------|-------------|------------|-------------|
| For educational use | Never | Once a week  | Once a day  |            | > Once a day |
| For professional use| Never | Once a week  | Once a day  |            | > Once a day |
3c) Please circle the box which describes how often you use YouTube.

|                      | Never | Once a month | Once a week | Once a day | > Once a day |
|----------------------|-------|--------------|-------------|------------|-------------|
| For socialising      |       |              |             |            |             |
| For educational use  |       |              |             |            |             |
| For professional use |       |              |             |            |             |

3d) Please circle the box which describes how often you use Wikipedia.

|                      | Never | Once a month | Once a week | Once a day | > Once a day |
|----------------------|-------|--------------|-------------|------------|-------------|
| For socialising      |       |              |             |            |             |
| For educational use  |       |              |             |            |             |
| For professional use |       |              |             |            |             |

4) How useful would you find each aspect if it featured on Facebook or Twitter? Please circle the appropriate number below.

| Aspect                             | Not useful | Not very useful | Neutral | Somewhat useful | Very useful |
|------------------------------------|------------|-----------------|---------|-----------------|-------------|
| Multiple choice questions          | 1          | 2               | 3       | 4               | 5           |
| Short answer questions             | 1          | 2               | 3       | 4               | 5           |
| Pictures and diagrams              | 1          | 2               | 3       | 4               | 5           |
| Links to other resources           | 1          | 2               | 3       | 4               | 5           |
| Videos and video links             | 1          | 2               | 3       | 4               | 5           |
| Q&As with lecturer                 | 1          | 2               | 3       | 4               | 5           |

What other features would you find useful?

Part 3: Professionalism

Instruction:

1) Please circle the appropriate number below

| Aspect                                                                 | Strongly disagree | Disagree a little | Neither agree nor disagree | Agree a little | Agree strongly |
|------------------------------------------------------------------------|-------------------|-------------------|----------------------------|----------------|----------------|
| I have separate personal and professional SMS accounts                 | 1                 | 2                 | 3                          | 4              | 5              |
| I am more worried about posting on SMS since starting university        | 1                 | 2                 | 3                          | 4              | 5              |
| I am more concerned about my privacy since starting university         | 1                 | 2                 | 3                          | 4              | 5              |
| I have changed my SMS habits since starting university                  | 1                 | 2                 | 3                          | 4              | 5              |
| I would confront a college that posted harmful content                  | 1                 | 2                 | 3                          | 4              | 5              |
| I am aware of the GMC/BMA guidelines on SMS use                         | 1                 | 2                 | 3                          | 4              | 5              |
| I have read the GMC/BMA guidelines on SMS use                           | 1                 | 2                 | 3                          | 4              | 5              |

Part 4: Additional Input

Do you want to see social media used more within medical education?

Yes ☐ No ☐

If yes how would you like to see it used?
Appendix 5: Questionnaire after the focus group

Social media use within medical education

The purpose of this survey is to evaluate what role social media can play in the medical curriculum, which platforms are most effective and how beneficial it can be. There is no obligation to complete this survey. Thank you for taking the time to complete this survey. By doing so you will imply consent for your responses to be used in research.

Demographic

Age: Gender: □ Male □ Female

Part 1: Review of learning tools

Instruction:
How useful do you find the different learning tools? Please circle the appropriate number in each row.

|                      | Not useful | Not very useful | Neutral | Somewhat useful | Very useful |
|----------------------|------------|-----------------|---------|-----------------|-------------|
| Textbooks            | 1          | 2               | 3       | 4               | 5           |
| Lecture material     | 1          | 2               | 3       | 4               | 5           |
| Journals             | 1          | 2               | 3       | 4               | 5           |
| Social media sites   | 1          | 2               | 3       | 4               | 5           |

Part 2: Social media platforms (SMP)

Definition: Social media is defined as any websites or applications that enable users to create and share content, to interact with other users, or to find people with similar interests to one’s own (e.g. Facebook, Twitter, YouTube, Wikipedia…)

Instruction:
1) Please circle the appropriate number below

|                      | Strongly disagree | Disagree a little | Neither agree nor disagree | Agree a little | Agree strongly |
|----------------------|-------------------|-------------------|----------------------------|----------------|---------------|
| I feel comfortable using SMP for: |                   |                   |                            |                |               |
| Social purposes      | 1                 | 2                 | 3                          | 4              | 5             |
| Educational purposes | 1                 | 2                 | 3                          | 4              | 5             |
2) Which social media platforms do you use and for what purpose? Tick the relevant boxes.

| Platform       | Social | Educational |
|----------------|--------|-------------|
| Facebook       |        |             |
| Twitter        |        |             |
| YouTube        |        |             |
| Wikipedia      |        |             |
| Blogs          |        |             |
| LinkedIn       |        |             |
| Mendeley       |        |             |
| Snapchat       |        |             |
| Instagram      |        |             |
| Other*         |        |             |

*If other, please indicate what platforms you use.

Please expand on how you use SMP for educational purposes eg. Closed discussion groups on Facebook

3a) Please circle the box which describes how often you use Facebook.

| Frequency       | For socialising | For educational use |
|-----------------|-----------------|---------------------|
| Never           |                 |                     |
| Once a month    |                 |                     |
| Once a week     |                 |                     |
| Several times a week |         |                     |
| Once a day      |                 |                     |
| > Once a day    |                 |                     |

3b) Please circle the box which describes how often you use Twitter.

| Frequency       | For socialising | For educational use |
|-----------------|-----------------|---------------------|
| Never           |                 |                     |
| Once a month    |                 |                     |
| Once a week     |                 |                     |
| Several times a week |         |                     |
| Once a day      |                 |                     |
| > Once a day    |                 |                     |

3c) Please circle the box which describes how often you use YouTube.

| Frequency       | For socialising | For educational use |
|-----------------|-----------------|---------------------|
| Never           |                 |                     |
| Once a month    |                 |                     |
| Once a week     |                 |                     |
| Several times a week |         |                     |
| Once a day      |                 |                     |
| > Once a day    |                 |                     |
3d) Please circle the box which describes how often you use Wikipedia.

|                     | Never | Once a month | Once a week | Several times a week | Once a day | > Once a day |
|---------------------|-------|--------------|-------------|----------------------|------------|-------------|
| For socialising     |       |              |             |                      |            |             |
| For educational use |       |              |             |                      |            |             |

4) How useful would you find each aspect if it featured on Facebook or Twitter? Please circle the appropriate number below.

| Aspect                        | Not useful | Not very useful | Neutral | Somewhat useful | Very useful |
|-------------------------------|------------|-----------------|---------|-----------------|-------------|
| Multiple choice questions     | 1          | 2               | 3       | 4               | 5           |
| Short answer questions        | 1          | 2               | 3       | 4               | 5           |
| Pictures and diagrams         | 1          | 2               | 3       | 4               | 5           |
| Links to other resources      | 1          | 2               | 3       | 4               | 5           |
| Videos and video links        | 1          | 2               | 3       | 4               | 5           |
| Q&As with lecturer            | 1          | 2               | 3       | 4               | 5           |
| Webinars/live recordings      | 1          | 2               | 3       | 4               | 5           |

What other features would you find useful?

Part 3: Professionalism

Instruction:
1) Please circle the appropriate number below

| Statement                                      | Strongly disagree | Disagree a little | Neither agree nor disagree | Agree a little | Agree strongly |
|-----------------------------------------------|-------------------|-------------------|---------------------------|---------------|----------------|
| I have separate personal and professional SMP accounts* | 1                 | 2                 | 3                         | 4             | 5              |
| I am more worried about posting on SMP since starting university | 1                 | 2                 | 3                         | 4             | 5              |
| I am more concerned about my privacy since starting university | 1                 | 2                 | 3                         | 4             | 5              |
| I have changed my SMS habits since starting university | 1                 | 2                 | 3                         | 4             | 5              |
| I would confront a college that posted harmful content | 1                 | 2                 | 3                         | 4             | 5              |
| I am aware of the GMC/BMA guidelines on SMP use | 1                 | 2                 | 3                         | 4             | 5              |
| I have read the GMC/BMA guidelines on SMP use | 1                 | 2                 | 3                         | 4             | 5              |

*Which SMPs do you use with separate personal and private accounts?

Part 4: Additional Input

Do you want to see social media used more within medical education?

Yes ☐ No ☐

If yes how would you like to see it used?

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Migrated Content

Version 1

Reviewer Report 20 May 2017

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Subha Ramani
Harvard Medical School, Brigham and Women's Hospital

This review has been migrated. The reviewer awarded 4 stars out of 5

The authors have done a remarkable job of reviewing this literature and organizing it well for a novice social-media user (non-user) like myself. I found it easy to review the various resources, how and why they are useful and advantages and disadvantages of each. I especially found the discussion of the learning theories quite illuminating and the qualitative themes very interesting. Developing the questionnaire after review of the literature and themes is a very appropriate approach. Since current and future generations of learners utilize these resources, I need to start learning more. The paper was quite lengthy and I wish it could have been a little more concise. Otherwise, this paper would be very useful to all educators interested in using social media in their teaching and I applaud the authors for their detailed descriptions and comprehensive review.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 19 May 2017

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Veena Rodrigues
Norwich Medical School
This review has been migrated. The reviewer awarded 3 stars out of 5

I think this is a valiant attempt to cover what could easily be two separate papers, the systematic review and its results and the construction, piloting and validation of a tool to inform social media use at the institution and elsewhere. One of the key strengths of this paper is the use of the PRISMA guidelines for reporting. Within the search strategy, the keywords and MeSH terms used in the Medline search are provided as is the flow diagram for study selection. However, the actual search history in Medline could have been presented fully to ensure that the methods are reproducible. The search terms included Facebook and Twitter but other social media used within medical education such as You tube, LinkedIn, etc could have been included too to ensure that the search was comprehensive. The authors extracted information from each study and summarise this in tables (appendices) to provide an overview. However, I could not find any information on the study quality assessment tool used. A validated tool such as the ‘Medical Education Research Study Quality Instrument’ (MERSQI) could have been used for assessing study quality. I think Appendix 2 could have included a score for each study quality based on quality assessment to ensure that the higher quality studies were given a higher weight in reporting the findings. The authors could also have indicated if studies used a comparator group (and what this was) in assessing benefits of social media. While minor typos are understandable but avoidable, of the six themes selected for exploration and discussion (community & interactivity, communication & feedback, learning theories, social media vs traditional didactic lectures, role of faculty and professionalism), only five were actually presented. The theme ‘social media vs traditional didactic lectures’ appears to have been missed out entirely within the discussion although it is included as a heading in appendix 2. I look forward to hearing updates from the authors on the results of their questionnaire surveys among students and how this informs curricular changes in future.

**Competing Interests:** No conflicts of interest were disclosed.

Reviewer Report 15 May 2017

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David Taylor
Gulf Medical University, Ajman, UAE

This review has been migrated. The reviewer awarded 4 stars out of 5

This is an interesting paper and I particularly liked the way the literature review informed the questionnaire design. There are three areas that I think might warrant further discussion. The first relates to the variety of uses of social media, which will each have a different impact on personal learning. In
Some contexts the social media are simply a way of accessing a repository of learning resources, in others they will provide personal, pastoral and arguably academic support. The second issue relates to the particular devices used, which might well frame the social media platform in use, and which has changed dramatically in the past five years or so, and is continuing to change as broadband speed and bandwidth increase. The third issue has been mentioned by other reviewers, and relates to the enthusiasm with which different groups of people adopt social media. This is an important article to read for anyone involved in understanding IT provision, and who is thinking about the next steps forward.

**Competing Interests:** No conflicts of interest were disclosed.

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**Reviewer Report 13 May 2017**

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**P Ravi Shankar**
American International Medical University

This review has been migrated. The reviewer awarded 4 stars out of 5

This is a very interesting and thought provoking review. I work in an offshore Caribbean medical school and count myself as being reasonably computer savvy. The authors mention an important problem with the use of social media in medical education. The millennial generation of students is the savviest with social media and their teachers are much less savvy. The older generation is now using computers quite comfortably but still has only a passing acquaintance with social media. I do use social media for communication but am still unfamiliar with using them more widely in medical education. Social media and the internet offer relatively smaller medical schools located in small Caribbean islands access to a variety of medical education resources and can democratize medical education. With relatively good internet speeds and a student population very active on social media I am exploring how to use social media to improve student learning. Most schools while having an information technology support staff do not have an educational technologist who can help faculty become more familiar with social media and how to use it to enhance student learning. It will be a challenge to help faculty reach the level where they can help with and provide guidelines to students regarding the use of social media for education. The paper is well written and the limitations are cleanly mentioned. As Catherine Hennessy is a coauthor I did not understand the acknowledgement section where she is thanked for her contributions. I may be interested in using the questionnaire developed by the authors for a study among year 1 and year 2 students in my institution.
Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 12 May 2017

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Iain Keenan
Newcastle University

This review has been migrated. The reviewer awarded 4 stars out of 5

This is an accomplished and interesting systematic review of social media in medical education. I have a particular interest in digital learning methods and particular social media in anatomy and medical education and I welcome practical recommendations with a strong theoretical and evidence base that support use of such technologies. The approach of utilising the review in order to develop a questionnaire is particularly effective. I look forward to reading about the results of the questionnaire in the future. A point I note in particular is with respect to the authors' observation that there have “only” been five previous systematic reviews of social media in medical education. When considering other learning and teaching approaches in the life sciences and medical education, and noting that social media have only become popular within higher education within the last decade, 5 systematic reviews seems huge in comparison to other learning methods. This is emphasised even further by the wealth of literature (including systematic reviews and meta-analyses) with respect to social media usage beyond medical education in higher education as a whole. There are certainly further educational approaches that would benefit from this amount of attention. However, it is certainly important to identify those questions that remain to be answered with respect to social media in education, so as not to unnecessarily repeat previous work on this topic. In a similar vein, a further point I noted was the that intention is to compare social media to other learning and teaching approaches in order to identify if social media are equally effective or more effective than other methods. I would be interested to know the authors thoughts with respect to this question in terms of whether they expect that social media will be used in the future to enhance student learning through increasing the variety of available learning and teaching methods and to complement and supplement current approaches, or whether they expect social media to completely replace some existing modalities. This may influence how this question is addressed in their future work. The main approach I can currently envisage being entirely replaced by social media would be virtual learning environments, which themselves have actually been considered to be social media by some previous authors. This leads to another point with respect to the definition of social media itself. There are many definitions of social media within the literature and it is important to establish from the outset what that definition actually is. It is also beneficial not to expect that every responder or research participant will have the same definition of social media so it is important that they
are either informed of the agreed definition or alternatively that their own particular definitions are identified within the research. Finally, it is always important not to fall into the “digital natives” trap when considering learning technologies including social media. Although this is an attractive idea and remains pervasive within the literature and the educational community, the notion of digital natives has been effectively discredited.

**Competing Interests:** No conflicts of interest were disclosed.

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**Ronald M Harden**

AMEE

This review has been migrated. The reviewer awarded 4 stars out of 5

I found this a useful review of the use of social media in medical education. From the introduction alone I picked up 3 messages ..1. Of value in creating a personal learning environment (Stephen Downes talk on PLEs at AMEE 2015), 2. Students need to learn how to make best use of SM. 3 Given the importance of role models there may be a problem with teachers serving as role models in the use of SM.I believe the future lies in a blended model and I would have liked to have seen more information about this eg how SM can contribute to a flipped classroom. However I did find of value the insights provided in the article. and recommend it as a useful read.

**Competing Interests:** No conflicts of interest were disclosed.
This review has been migrated. The reviewer awarded 4 stars out of 5

This paper by Whyte & Hennessy describes a significant piece of scholarship about the use of social media (SM) in medical education. The systematic review (SR) results in the narrative synthesis and appraisal of data (and study design) from 27 primary studies. The paper also describes the design and revision of a questionnaire to explore student experiences and opinions of SM and explores 6 major themes; including the role of faculty, learning theories and professionalism. I enjoyed reading this paper and it addresses some of the questions posed in our editorial. I am delighted that the corresponding author, of this first paper reviewed for the themed-issue, is both a medical student and a Life Sciences graduate (see notes on contributors). The generalizable conclusions that can be drawn from the SR are limited by the quality of the primary studies (the authors appraise and describe the study designs. For example, they note in their discussion that only one of seven studies describing the use of Twitter included a control cohort). There are a lot of strengths that should be highlighted for this SR & questionnaire validation: 1. Medical educationalists have embraced social media rapidly in recent years and it is important that data from any observational and interventional studies should be carefully scrutinised to inform practice. This SR includes citations that will be of great value to other academics exploring the topic, including the 5 previous systematic reviews about this subject. Whyte & Hennessy identified primary studies from the point in 2014 when the most recent previous SR manuscript was submitted. So the rationale/justification for this systematic review is clear. 2. The authors follow BEME & PRISMA guidelines in the conduct of the SR & share all data in figures and tables, either in the main body of the text or in the appendix. 3. The authors explore the limitations of the primary literature, tables 2 & 3 in the appendix are particularly useful to anyone navigating the literature. 4. The authors note the lack-of/need-for quantitative data from well-designed studies. 5. Trialling the questionnaire with a focus group allowed the authors to decide if their quantitative parameters were granular enough. A few suggestions: • One principle of the SR is that clear questions should be defined as part of the protocol design; and answering a particular question is very important in the synthesis of useful information from primary studies. I think the rather open-ended objectives meant that the authors had to grapple with rather heterogeneous themes throughout. I have found that 2 things have always helped me to be very focused and clear when conducting systematic reviews (1) the use of a PRISMA checklist, http://prisma-statement.org/PRISMAStatement/Checklist.aspx from the outset, that I would publish in the appendix or submit as supplementary information with the manuscript (2) registering the protocol on the PROSPERO database; https://www.crd.york.ac.uk/PROSPERO/ • Although mainly clear and interesting throughout, there were a few typos/syntax issues and the manuscript could have been a bit more succinct in a few places e.g. there is some meandering away from stated SR objectives in a few places (probably reflecting the educational interests of the authors, and frankly I still enjoyed reading about these reflections on anatomy teaching and learning). Perhaps it could have benefitted from a final edit and draft? With post-publication peer review and with copy-editing being the author’s responsibility it is always worth a careful and rigorous final edit of the manuscript. A few questions for the authors: • Do you plan to design a parallel questionnaire to explore the experiences and observations from academics too? • In the discussion you identify features of SM interventions linked to the learning of anatomy; do you think these would be generalizable to the other Life Sciences? • One of the research questions in your questionnaire is How beneficial is social media to teaching...? Given the perspectives of the participants this is designed
for, I wonder if the word teaching should be replaced with the word learning.

**Competing Interests:** No conflicts of interest were disclosed.

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**Trevor Gibbs**

AMEE

This review has been migrated. The reviewer awarded 4 stars out of 5

A very interesting and informative paper, covering a very important area- and I say that with honesty as someone who is very anti-social media! It was very healthy to read of a school researching a subject before just jumping into a methodology / technique just because it is there and assuming that all students come to medical school apparently social media savvy. I feel that this is a very good paper that should be read by all those interested in the area concerned and those considering implementing social media into their curriculum teaching and learning toolbox. If I was to improve the paper, I would suggest that in its present form it appears positively skewed towards social media and I would have liked to see more exploration on the negative aspects.

**Competing Interests:** No conflicts of interest were disclosed.

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**Ken Masters**

Sultan Qaboos University

This review has been migrated. The reviewer awarded 5 stars out of 5

A very well researched and written paper. There are some minor typographical errors, and one should
also note Wikipedia does have qualifying editing restrictions on some of its pages. Nevertheless, not only for the purposes of designing the questionnaire, the paper gives an excellent over view of the current use of social media in medical education. I would also like to have seen some reference to social media addiction by medical students, as this is becoming an increasing problem, but, given that the paper is already fairly expansive, it could not include everything. Finally, in the delivery of your questionnaire, just as some students were unaware that Wikipedia and YouTube were social media platforms, so many students would be unaware of Mendeley in this role, and see it only as a reference manager, so you might find yourself needing to explain its inclusion in your questionnaire.

**Competing Interests:** No conflicts of interest were disclosed.