Received: 26 October 2020 | Revised: 6 May 2021 | Accepted: 8 May 2021

DOI: 10.1111/medu.14567

MEDICAL EDUCATION IN REVIEW

Social media in undergraduate medical education: A systematic review

Jonathan Guckian[1,2] | Mrudula Utukuri[3] | Aqua Asif[4] | Oliver Burton[5] | Joshua Adeyoju[6] | Adam Oumeziane[7] | Timothy Chu[2] | Eliot L. Rees[8,9]

[1]Dermatology Department, Leeds Teaching Hospitals NHS Trust, Yorkshire, UK

[2]School of Medical Education, Newcastle University, Newcastle Upon Tyne, UK

[3]School of Clinical Medicine, University of Cambridge, Cambridge, UK

[4]Leicester Medical School, University of Leicester, Leicester, UK

[5]Warwick Medical School, University of Warwick, Coventry, UK

[6]Faculty of Medicine, University of Southampton, Southampton, UK

[7]School of Medicine, Anglia Ruskin University, Chelmsford, UK

[8]School of Medicine, Keele University, Newcastle-under-Lyme, UK

[9]Research Department of Primary Care and Population Health, University College London, London, UK

Correspondence
Eliot L. Rees, School of Medicine, Keele University, KH77, Keele Hall, Newcastle-under-Lyme ST5 5BG, UK.
Email: e.rees@keele.ac.uk

Funding information
National Institute for Health Research Academic Clinical Fellowship, Grant/Award Number: ACF-2020-18-021

Abstract

Introduction: There are over 3.81 billion worldwide active social media (SoMe) users. SoMe are ubiquitous in medical education, with roles across undergraduate programmes, including professionalism, blended learning, well being and mentoring. Previous systematic reviews took place before recent explosions in SoMe popularity and revealed a paucity of high-quality empirical studies assessing its effectiveness in medical education. This review aimed to synthesise evidence regarding SoMe interventions in undergraduate medical education, to identify features associated with positive and negative outcomes.

Methods: Authors searched 31 key terms through seven databases, in addition to references, citation and hand searching, between 16 June and 16 July 2020. Studies describing SoMe interventions and research on exposure to existing SoMe were included. Title, abstract and full paper screening were undertaken independently by two reviewers. Included papers were assessed for methodological quality using the Medical Education Research Study Quality Instrument (MERSQI) and/or the Standards for Reporting Qualitative Research (SRQR) instrument. Extracted data were synthesised using narrative synthesis.

Results: 112 studies from 26 countries met inclusion criteria. Methodological quality of included studies had not significantly improved since 2013. Engagement and satisfaction with SoMe platforms in medical education are described. Students felt SoMe flattened hierarchies and improved communication with educators. SoMe use was associated with improvement in objective knowledge assessment scores and self-reported clinical and professional performance, however evidence for long term knowledge retention was limited. SoMe use was occasionally linked to adverse impacts upon mental and physical health. Professionalism was heavily investigated and considered important, though generally negative correlations between SoMe use and medical professionalism may exist.

Funding information Eliot Rees is funded by a National Institute for Health Research Academic Clinical Fellowship: ACF-2020-18-021. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

Conclusions: Social media is enjoyable for students who may improve short term knowledge retention and can aid communication between learners and educators. However, higher-quality study is required to identify longer-term impact upon knowledge and skills, provide clarification on professionalism standards and protect against harms.

1 | INTRODUCTION

The explosion of Social Media (SoMe) has infiltrated all aspects of modern society. The scale of the phenomenon can be daunting to conceptualise. There are over 3.81 billion worldwide active users,[1] while individuals have an average of seven accounts each.[2] Facebook, the most popular platform, boasts over a billion more users than the population of China, the world's most populous country.[1,3]

It is perhaps inevitable that this technology would become ubiquitous within medical education delivery. Our field craves innovation and strives to adapt its future workforce to changing environments.[4,5] There are few arenas as chaotic as SoMe: since its conception, hundreds of platforms have risen in prominence before falling into obscurity.[6] Various platforms have been utilised within undergraduate medical education curricula, with roles in professionalism,[7] blended learning,[8] student well-being[9] and mentoring[10] representing a fraction of their application.

The argument for the integration of SoMe into educational practice is supported by multiple theoretical standpoints, including the development of rapid, accessible communities of practice,[11] based upon constructivist principles, generated during classes,[12] conferences[13] or conversations.[14] Moreover, connectivism is a 'new' educational theory, mirroring constructivism, born out of such technology enhanced learning.[15]

Research to date examining the impact of SoMe use on medical students' academic attainment has found no relationship between daily usage, platform preferences and performance on summative assessments.[16] The majority of medical students have SoMe accounts. This has resulted in a powerful tool that can reach virtually every student on platforms already integrated into their daily lives.

As educators, it is no longer a question of whether SoMe has educational applications, or whether undergraduate populations are actively using these platforms for their learning. Rather, we should be asking how best to utilise SoMe, and whether such platforms can facilitate specific outcomes.

Previous systematic reviews of SoMe in medical education have investigated outcomes and efficacy.[17-19] However, these took place before the SoMe 'boom' of recent years, revealing a paucity of high-quality empirical studies assessing the effectiveness of SoMe in medical education. An updated review, synthesising contemporary SoMe scholarship, is required for the current landscape.

In the advent of the COVID-19 pandemic, a once-in-a-century event, the medical education community has transformed.[20] There have been calls for a new paradigm of educational delivery through technology-enhanced learning,[21] with SoMe at the forefront of this revolution.[22] It is imperative that, before committing to placing SoMe as a foundation of any new approach, we critically examine the evidence for its efficacy.

This review aims to synthesise the evidence regarding SoMe interventions in undergraduate medical education, in order to identify features associated with positive and negative outcomes.

2 | METHODS

This is a systematic review reported in accordance with the STructured apprOach to the Reporting In healthcare education of Evidence Synthesis (STORIES) statement.[23]

2.1 | Search strategy

We performed an electronic search of 31 terms and their Boolean combinations (illustrative full terms for one database are provided in Appendix S1) through seven databases: Medline, Cumulative Index of Nursing and Allied Health Literature (CINAHL), British Education Index (BEI), Education Resources Information Center (ERIC), Embase, PsycINFO, Applied Social Sciences Index and Abstracts (ASSIA), and the Australian Education Index. Search terms were derived through reviewing keywords of papers identified through a pilot search, and a list of social media platforms. No limits were imposed. Searches were performed between 16th June and 16th July 2020 by one reviewer (ER).

We scrutinised reference sections and performed forwards citation tracking of all included papers using PubMed's 'cited in' feature, and previous pertinent reviews in order to identify further relevant papers. One reviewer (JG) hand searched the full contents of one journal (MedEdPublish) that was considered relevant but not indexed in the above electronic databases. This journal was chosen as studies identified in the reference section of identified papers were published here, and we were aware that it was not indexed in any of the databases we had searched.

All citations were downloaded and imported into web-based systematic review software (DistillerSR, Evidence Partners,

Ottawa, Canada) in order to facilitate screening and data extraction.

2.2 | Inclusion and exclusion criteria

For inclusion, articles had to provide primary data on the use of SoMe amongst undergraduate medical students. Studies describing SoMe interventions and research on exposure to existing SoMe were both included. Only English language papers were included.

Defining SoMe has become increasingly challenging as platforms diversify. We accept in principle the definition of SoMe articulated by Cheston et al, later adopted by Sutherland and Jalali, describing SoMe as "Web-based technologies that facilitate multi-user interaction that goes beyond fact sharing".[17,19]

Given the evolution of SoMe since the development of this definition in 2013, more recent examinations should be considered. Chan et al[24] highlight that platforms "facilitate creation and distribution of content", which may be "user-generated or user-curated" to "virtual communities of practice". We would therefore add to Cheston et al's definition that 'such interactions may take place in either public or private domains', stipulate that 'the primary purpose of the platform must be multi-directional interaction' and 'be centred around content creation, curation and community'. Using our adapted definition, we considered true SoMe platforms to place user interaction at their heart. We, therefore, exclude websites or blogs which happen to feature a comments page, as "multi-directional interaction" is a secondary purpose in these instances. We also exclude podcasts on the basis that they are generally unidirectional in nature. YouTube was included as user creation is often driven by community comments, users may curate content and video replies are common.

We defined undergraduate medical education as any educational aspect of the period between the commencement of medical school and graduation.

2.3 | Screening of studies

All titles were independently screened by two reviewers (from MU, AA, OB, JA, AO, TC). Reviewers prioritised sensitivity over specificity at this point, so any titles that could *potentially* have been relevant to our review objective were included. Disagreements progressed to abstract screening in order to enable a more informed decision to be made.

Abstracts of all papers included from title screening, and all papers identified through reference and hand searching were screened against inclusion criteria by two reviewers (from MU, AA, OB, JA, AO, TC). If it was not clear from the abstract whether the paper met the inclusion criteria, it was included for full-text screening. Disagreements at the outcome or criterion level (ie both reviewers elect to exclude but based on different exclusion criteria) were resolved by a third reviewer (ER or JG).

Papers that met inclusion criteria in abstract screening, or for which insufficient information was presented to enable a judgement, were read in full and reviewed again against the review's inclusion and exclusion criteria. Full-paper screening was conducted independently by two reviewers (ER & JG). Conflicts were resolved through discussion.

2.4 | Data extraction

A pilot data extraction form was developed. All reviewers independently reviewed two papers and met to ensure we were extracting consistently and to revise the fields in the coding form. Once the form was finalised, all reviewers independently reviewed a further two papers and met to ensure consistency. Following this pilot phase, all papers were reviewed by two reviewers (one from MU, AA, OB, JA, AO, TC and either ER or JG).

The following data were extracted:

- Participants (country, profession, stage of training, number)
- Intervention (focus, aim, brief overview, duration, SoMe platforms used) or Exposure (research question, overview of exposure, SoMe platforms investigated)
- Evaluation methods (impact of intervention using modified Kirkpatrick's hierarchy,[25] study design, data collection methods)
- Results (summary, results for each Kirkpatrick level investigated, key conclusions)

We calculated kappa values for full data extraction and quality assessment.

2.5 | Assessment of methodological quality

All included papers were assessed for their methodological quality using two or more tools.

Depending on whether papers employed quantitative and/or qualitative methods, they were assessed for their methodological quality using the Medical Education Research Study Quality Instrument (MERSQI) and/or the Standards for Reporting Qualitative Research (SRQR) instrument, respectively. The MERSQI is a tool containing 10 items in six domains: study design, sampling, type of data, the validity of evaluation instrument, data analysis, and outcomes.[26] The SRQR comprises of 21 reporting standards for high-quality qualitative research.[27]

Papers describing educational interventions were assessed for risk of reporting bias using the risk of bias measure described by Gordon et al.[28] This assesses the risk of bias due to incomplete reporting of educational interventions. Included papers were assessed against five sources of potential bias using a three-point scale. Papers that provided adequate description were considered low risk of bias, those that provided some but insufficient details were rated as unclear risk

of bias, and those that did not provide any details were rated as high risk of bias. The potential sources of bias considered were the theoretical underpinning of the development, the resources required, the setting, the educational methods employed, and the content.

An overall rating of the strength of the conclusions drawn by the authors was made using the BEME collaboration's five-point scale.[25]

2.6 | Synthesis of evidence

Extracted data were synthesised using narrative synthesis. This involves synthesising the findings from primary studies textually, without conducting meta analyses.[29] This approach enabled this review to synthesise findings from both qualitative and quantitative studies to provide a comprehensive synthesis of the research literature in this field.[30] The review group met virtually every week throughout the data extraction and synthesis phases to discuss evolving findings. We constructed overview findings for the subgroups of intervention studies and exposure studies. We undertook conceptual mapping to identify themes within which to synthesise and present the findings of primary studies.[31]

3 | RESULTS

Database searches yielded a total of 1,442 papers. A further 321 papers were identified through reference and citation searches, and 44 through hand searching. Deduplication identified 720 duplicates, leaving 1087 papers for screening. Title and abstract screening excluded 327 and 441 papers, respectively. After reviewing the full texts of 319 full papers, 112 met our inclusion criteria and were included in the final review. An illustration of record flow can be found in Figure 1. Weighted overall Kappas for data extraction and quality assessment using MERSQI and SRQR were 0.98, 0.96 and 1.00, respectively.

3.1 | Details of included papers

The studies included participants from 26 different countries across six continents: Asia (37), North America (33), Europe (28), Australia (20), Africa (1), and South America (1). There were an additional six international studies that included participants from multiple countries.

Thirty-nine papers included preclinical students, 32 included clinical students, 21 included all stages of students, and 20 did not describe the stage of included medical students. For the purposes of this review, preclinical students were in Years 1 and 2 whilst clinical students were in Years 3, 4 and 5. Fourteen studies also included postgraduate clinical trainees, 10 included non-training grade doctors (eg consultants/attendings, general practitioners), 7 studies included other health professionals, and 17 included other students. There was a total of 35,428 participants across the included studies. These consisted of a median (range) of 151 (6-4244) participants per study.

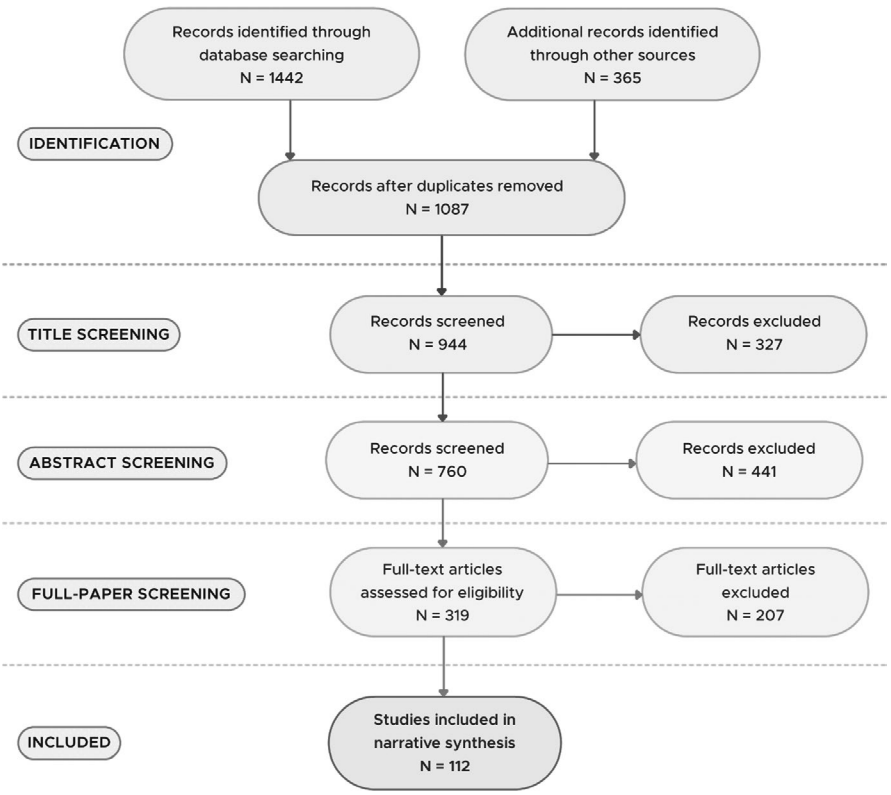

FIGURE 1 PRISMA diagram of studies

3.2 | Summary of SoMe interventions/exposures

Twenty-nine different SoMe platforms were studied. The most common was Facebook (65/112, 58%), followed by Twitter (37/112, 33%) and YouTube (33/112, 29%). Forty (36%) studies investigated the use of more than one SoMe platform.

Fifty-eight out of the 112 included studies (52%) involved the development of novel SoMe teaching (intervention studies) whilst the other 54 (48%) focussed on how students currently utilise SoMe platforms in medical education (exposure studies).

3.2.1 | SoMe Interventions

Novel SoMe interventions were created with the aims of: (a) improving knowledge and skill development; (b) supporting curricular activities; and (c) assessing the acceptability of SoMe.

Types of knowledge and skill development included information acquisition and retention,[32-44] reflection[45-47] and professionalism.[40,48,49,50,51,52,53,54,55,56,57] Supporting curricular activities ranged from enhancing student engagement,[58-68] reducing student anxiety with the taught material[69-71] to improving communication between faculty and students[69,72,73,74] and between students themselves outside of the classroom.[38,69,75,76] Many interventions were evaluated to assess student opinions and attitudes towards inclusion of SoMe within their medical curriculum.[8,14,34,49,70,77,78,79,80,81,82,83,84,85,86,87] Privacy was a focus of 28/58 (48%) SoMe interventions with the use of closed gro ups,[32,45,48,68,70,72,74,75,87,88] private communication platforms such as WhatsApp and WeChat[14,33,34,35,36,37,38,50,51,60,62,66,78,80,81,82,83] and even a bespoke institution-specific SoMe platform.[53] 16/58 (28%) studies involved case-based or problem-based learning.[8,14,35,39,48,49,50,54,62,65,66,67,74,78,83,87]

3.2.2 | Exposures to SoMe

Of the 54 included studies addressing exposures to SoMe-mediated medical education, the most prevalent focus was assessing usage patterns of SoMe platforms by students, seen in 38 studies (70%). Projects looked to identify SoMe platforms and services most commonly used[89-92] and the duration or purpose of such use.[93-95]

The second major theme was that of professionalism (17/54, 31%). In particular, student and faculty behaviour online was analysed for whether these behaviours met regulator standards.[96,97] Questions were raised as to whether SoMe makes students and doctors more likely to have lapses in professional behaviour,[98] whether guidelines in professional SoMe use are necessary,[99] and who should be responsible for producing and leading them.[100-102] Several studies explored professionalism in the context of acceptable patient interaction.[103,104]

The findings from included studies have been grouped thematically into six groups: usage, acceptability, educational activity, academic performance, professionalism, and health risks.

3.3 | Usage

SoMe use by undergraduate medical students is widespread.[105] Facebook was identified as the most popularly used platform amongst this group,[90,94] although YouTube and WhatsApp were the most favoured platforms for educational content.[89] Between a third and a half of students used social media for educational purposes on a daily basis.[89,90] Frequency of social media usage was not associated with gender or academic year.[106] Stopping the use of Facebook was associated with a sense of loss.[107]

3.4 | Acceptability

SoMe were generally perceived favourably by medical students. Enjoyment and engagement with various SoMe platforms were described. Only two studies differed: one found students' opinion on SoMe efficacy to be 'divisive',[90] whilst another described less than half of their student population finding a SoMe intervention useful in their studies.[58]

Usability was key to effective SoMe use in medical education.[14,36,63,77,108,109,110] Familiarity with SoMe platforms was a mediator of success. Indeed, unfavourable student reviews were reported when unfamiliarity was highlighted.[58] One study with a bespoke SoMe platform reported that students required greater accessibility and a more user-friendly interface.[53] Technological issues and poor digital literacy may contribute to inconsistencies in the effectiveness of SoMe interventions.[62,66]

The amount of information presented via a SoMe platform contributed to its effectiveness. Students preferred short content[44,77,81,85] with the "time-consuming" nature of searching SoMe for relevant information contributing to ineffectiveness.[111,112] It is suggested that the need to regularly check SoMe to keep up to date with content contributes to such inefficiencies; however, push notifications may improve this.[38,63] Type of educational information was also important, with many studies reporting a preference for SoMe posts that inform and test, for example, quizzes[109,113] and images with missing labels.[64] Visual posts with images[85] and videos[114] were suggested to be effective methods of disseminating information on SoMe, with one study reporting that highly visual platforms such as Instagram and Snapchat are the most popular amongst students for medical education.[115]

One study argued that SoMe platforms may be perceived as more user friendly and less academic than institutionally designed solutions. This study used Facebook and YouTube to deliver peer developed resources to alleviate stress and depression amongst recent entrants to medical school.[70] Contributions were monitored by a trained mental health professional.

One concern with SoMe in medical education was the lack of critical appraisal performed by students on the information presented.[75,84,108,116] Content creation by faculty members[61,76,108] may be a solution to this but adds to the workload of the educators.[114] Many studies argue that training is required for both staff and students to capitalise on the benefits of SoMe interventions in medical education.[8,49,62,75,79,101,117,118]

3.5 | Educational activity

Social media platforms were used in myriad ways. Educators used them to share resources, establish a dialogue with students, and facilitate classroom activities. Students used them for informal conversation, for accessing and sharing educational resources, to arrange educational and social events, to discuss opinions, and to participate in surveys, quizzes and educational games.[90,109,110,113]

Several studies delivered structured teaching using social media platforms.[6,36,48,65,85] Use of social media within structured learning activities was found to improve communication and participation,[82,88] and facilitate teamwork.[62,82]

Several studies reported that SoMe initiatives made students feel more able to ask questions to their peers, compared to asking questions in a clinical setting,[87] in part driven by an expectation that they would generally receive answers to questions more quickly from a multitude of voices, especially international professionals.[74,119] Students reported a change in the student-educator relationship.[14,37,120] They perceived SoMe as having "flattened hierarchies", allowing students to feel more comfortable interacting with educators.[14,121] Similar improvements furthered peer communication and working,[62,88] with facilitators in one study noticing greater student collaboration with SoMe.[62] Students reported newfound appreciation and interest for the subject material when presented with novel SoMe options for learning for example videos on YouTube[59] and discussion groups on Facebook.[64,88]

SoMe were also commonly used to supplement classroom teaching.[62,67,72,73,74] One study utilised SoMe to create a 'flipped classroom' in which a case was reviewed by participants on Twitter before classroom sessions.[67] Classroom discussions were described as more efficient, and Twitter lessened the educator burden. SoMe was found to enhance communication and collaboration between students and educators[69,72,74,106,112] as well as students and their peers.[62,69,72,83,106,112,122]

Students reported SoME facilitated them being more productive in their studies,[16] and enabling them to work faster.[120] Video-based SoMe platforms were considered to be particularly useful.[95,114,116] SoME were also considered useful in supporting reflective practice.[46]

Finally, SoMe were considered useful in learners' professional identity formation.[53,118]

3.6 | Academic performance

Subjective improvements in students' self-reported performance[56,60,63,123,124] and objective increases in assessment outcomes[33,35,38,40,69,82,125] were reported, including in two studies with controlled designs.[32,80] However, it is unclear whether the differences found in the latter two studies result from the use of SoMe or other confounding variables such as weekly assessment[32] or earlier exposure to educational material.[80] Some studies showed that the rate of utilisation of SoMe positively correlated with test score,[37,39,69] however, others suggested time spent on SoMe had no impact on knowledge improvement.[126] Furthermore, most interventions tested participants' knowledge and skills acquisition in the short term, with limited findings on long-term effectiveness.[44] Knowledge retention in the long term may be poorer with SoMe learning compared to lecture-based learning.[39]

Three studies demonstrated no effect from SoMe on academic performance.[34,36,61] However, one studied 'technology enhanced learning' (including SoMe), making it difficult to identify any SoMe specific results[61] and another did not assess baseline knowledge between the experimental and control group prior to intervention.[34] In one study, students linked social media use to subjectively worse test performance.[127]

The studies reporting higher academic performance tended to be dialogue-focussed, using push notifications, poll quizzes and closed communities of practice. They generally used WhatsApp, Facebook Groups and WeChat.

3.7 | Professionalism

One concern with the use of SoMe was maintaining professionalism. One study assessed students' Facebook activity levels and perceptions of guidelines for professional behaviour,[128] while another tested their response to simulated medical professionalism scenarios.[129] The latter demonstrated an inverse correlation between having a personal board on PTT, Taiwan's largest SoMe platform and humanism, as well as a similar correlation between SoMe use and medical professionalism scores.[128] This was despite the fact that SoMe use was actually associated with increased awareness of the need for professional behaviour on SoMe.[128] Additionally, despite this negative correlation, some students highlighted that SoMe, specifically Twitter, allowed them to develop empathy and understand previously unknown elements of patient experience.[119]

One study indicated that simply by surveying students on contentious behaviours (in this case patient-targeted googling, PTG) the act of surveying may reduce the incidence of such behaviours.[130] Students involved favoured more explicit teaching around PTG and such surveys may represent an opportunity to improve levels of professionalism.

Multiple studies found that students' behaviours were subject to change with the knowledge that their peers would be able to view the content they posted.[45,52] This may be linked to increasing awareness of professionalism, and one study found that approximately 11% of the SoMe profiles assessed were deemed to have committed some form of violation.[131]

TABLE 1 Medical Education Research Study Quality Instrument (MERSQI) scores for included quantitative studies

		Studies		Score		Mean (SD)			
Domain	MERSQI Item	No.	(%)	Item	Maximum Domain	Item		Domain	
Study design	1. Study design				3	1.23	0.47	1.23	0.47
	Single group cross-sectional or single group post-test only	63	75%	1					
	Single group pre-test and post-test	10	12%	1.5					
	Nonrandomised, 2 group	8	10%	2					
	Randomised control trial	3	4%	3					
Sampling	2. No. of institutions studied				3	0.63	0.33	1.52	0.55
	1	73	87%	0.5					
	2	1	1%	1					
	>2	10	12%	1.5					
	3. Response rate, %					0.99	0.45		
	N/A	8	10%						
	<50 or not reported	32	38%	0.5					
	50-74	14	17%	1					
	≥75	30	36%	1.5					
Type of data	4. Type of data				3	1.57	0.91	1.57	0.91
	Assessment by study participant	60	71%	1					
	Objective measurement	24	29%	3					
Validity of evaluation instrument	5. Internal structure				3	0.29	0.46	1.06	1.01
	N/A	4	5%						
	Not reported	57	68%	0					
	Reported	23	27%	1					
	6. Content					0.56	0.50		
	N/A	2	2%						
	Not reported	36	43%	0					
	Reported	46	55%	1					
	7. Relationship to other variables					0.24	0.43		
	N/A	1	1%						
	Not reported	63	75%	0					
	Reported	20	24%	1					
Data analysis	8. Appropriateness of analysis				3	0.88	0.33	2.43	0.65
	Data analysis inappropriate for study design or type of data	10	12%	0					
	Data analysis appropriate for study design or type of data	74	88%	1					
	9. Complexity of analysis					1.55	0.50		
	Descriptive analysis only	38	45%	1					
	Beyond descriptive analysis	46	55%	2					
Outcomes	10. Outcomes				3	1.31	0.39	1.31	0.39
	Satisfaction, attitudes, perceptions, opinions, general facts	47	56%	1					
	Knowledge, skills	22	26%	1.5					
	Behaviours	15	18%	2					
	Patient/health care outcome	0		3					
Total Score					18			9.11	2.30

Two articles indicated that in response to participating in the study, students would actively change their SoMe profiles to be less publicly accessible.[52,54]

Even though students understood the need for professionalism when using SoMe for medical education,[49,93,107,125,132,133,134] they appreciated educational interventions with regards to this.[40,56,135,136] Studies suggested privacy concerns were a barrier to effective SoMe use [47,64,69] but closed SoMe groups or bespoke networks may alleviate such concerns.[53,74] This does, however, limit global interactions[53] and only three studies identified accessing expertise from around the world as an advantage.[74,116,119]

3.8 | Health risks

Medical students generally reported using SoMe for at least six hours per week,[137] reporting poor health behaviours when using Facebook such as holding urine, skipping meals, and midnight logins, leading to disturbed sleep,[105,138] headaches, back and shoulder pain and eye irritation.[139] One study linked SoMe use to increased risk of anxiety & depression,[140] whilst two suggested SoMe may contribute to social isolation.[139,141]

3.9 | Methodological quality of included papers

Eighty-four (75%) papers utilised quantitative (including mixed methods) designs. The mean (SD, range) MERSQI score for these papers was 9.1 (2.3, 5-14) out of 18 (Table 1). These studies predominantly employed a single group design with a single data collection point (63, 75%), at a single institution (73, 87%), using subjective data (60, 71%). Almost half (38, 45%) of these studies reported descriptive statistics only, although 88% were considered to be appropriate for the design and types of data collected. The domain with the poorest scores was the validity of the evaluation instruments used.

Thirty-one papers utilised qualitative designs. The mean (SD, Range) SRQR score was 9.03 (3.99, 2-16). Included studies were strongest at reporting the context (30/31, 97%), data collection methods (28/31, 90%), units of study (25/31, 81%), sampling strategies (23/31, 74%), data analysis methods (22/31, 71%), and ethical issues (22/31, 71%). They were weakest at providing rationales for techniques to enhance trustworthiness (2/31, 6%), data analysis methods (4/31, 13%), sampling strategies (7/31, 23%), data collection methods (12/31, 39%), and describing researcher characteristics and reflexivity (13/31, 42%).

Overall, the risk of bias in reporting educational interventions was reasonable (Figure 2). There were no sources of bias where over 50% of papers were considered to be at low risk of bias. The highest sources of potential bias were in reporting details regarding the settings in which interventions took place and in the educational methods used.

Finally, the modal (mean, range) strength of conclusions was 3 (2.95, 1-4) indicating that these conclusions could probably be based on the results.

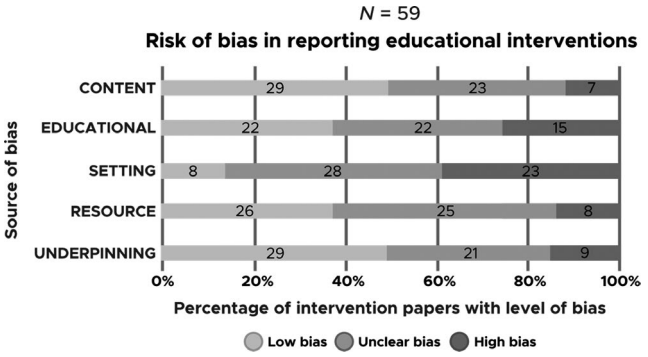

FIGURE 2 Risk of bias in reporting educational interventions in included studies

4 | DISCUSSION

This review identified 112 articles studying SoMe use in undergraduate medical education. Students generally have a favourable view of using SoMe for their learning, particularly when engaging with content hosted on familiar platforms and provided in small chunks. Acceptability is driven by the perceived flattening of hierarchies, improved accessibility to faculty and platform novelty. There is some evidence of SoMe interventions resulting in improved learner performance, though this is mainly limited to self-report, non-controlled studies or short-term changes. SoMe interventions which encourage dialogue between educator and student or between peers are most effective. Whilst students have reservations about professional conduct on SoMe, educational interventions aimed at developing professional SoMe behaviours are appreciated and appear to be effective. The methodological quality of studies investigating SoMe in medical education remains poor.

4.1 | Methodological quality of primary studies

It is telling that our review has included 98 more studies than a review in 2013 and 83 more studies than one in 2017, demonstrating the proliferation of SoMe in educational scholarship.[17,142] This review considers a wider variety of platforms that focussed on multidirectional communication than earlier investigations. Previous reviews were mostly comprised of blogs and Wikis,[17] which were excluded in this review.

However, this profound increase in studies has not been matched by an increase in quality. The mean (SD, range) MERSQI of previous reviews were 8.89 (3.39, 5-15.5),[17] and 9.57 (2.02, 7.5-14.5).[142] Our review identified a mean between those of these two previous reviews, and a lower maximum MERSQI score. While ours is the first SoMe review to use the SRQR to assess methodological quality of qualitative research, Sterling's review[142] reported reasonable quality of included qualitative research using the COREQ criteria (Consolidated Criteria for Reporting Qualitative Research).[143] This

suggests that while much of the literature on SoMe remains of relatively poor quality, research on SoMe in graduate medical education appears to be of higher quality.

Several previous studies have examined the impact of SoMe upon student outcomes, with focuses on the impact upon knowledge. Whilst Cheston's review concluded that their intervention studies led to equivalent test scores for students who did and did not use SoMe tools,[17] another found Facebook to be beneficial to the affective aspects of learning and YouTube to be an inadequate source of information for medical education.[19] However, the latter review describes its study outcomes as weak, poorly transferrable and relying on self-reporting. Our results conversely demonstrate subjective and objective knowledge improvement across several platforms, however, cautions against the relatively strong likelihood of confounders, suggesting that the benefits are likely limited to the short term. We echo the findings of Chan et al,[24] where the majority of studies consisted of descriptive research, assessed lower-level Kirkpatrick hierarchies and were methodologically dominated by single-centre quantitative surveys.

Whilst SoMe platforms have grown in number across reviews and time, the subject of an investigation by studies does not appear to have changed dramatically. The dominant themes explored by Cheston et al (2013), namely professionalism and improvement in knowledge, are reflected in this review, in addition to that of Sterling et al (2017) and Sutherland & Jalali (2017).[17,19,142]

4.2 | Strengths and limitations

While this is not the first systematic review of SoMe use in undergraduate medical education, we have identified significantly more papers than previous reviews. We believe this review has benefited from a rigorous and sensitive search strategy including multiple databases, reference, citation, and hand searching. We have benefitted from the insights and interpretations of both medical students and medical school faculty in the extraction and synthesis of original papers. We have included studies evaluating interventions and those researching exposure to SoMe, resulting in a comprehensive synthesis.

These strengths notwithstanding, this review does have some limitations. Firstly, while we believe the focus on undergraduate medical education is a strength, it also limits the generalisability of these results to other groups of learners. SoMe are used in different ways by practising physicians and therefore assumptions cannot be drawn regarding outcomes in SoMe across the spectrum of medical education. We did not contact the authors of included studies for missing data, further details or to identify other relevant or forthcoming literature. We have only included published journal articles in this review and have excluded conference abstracts. This may have resulted in the omission of innovative SoMe approaches that have not yet materialised in the peer-reviewed literature. Finally, as with all reviews, the results of this review are limited by the quality of the primary studies available for inclusion.

4.3 | Implications for practice and research

For the educator designing social media education tools, the best practice appears to be grounded in familiarity and features intensive induction for staff and learners. The most subjectively appreciated interventions appear to be highly visual, curated by faculty and blended with classroom teaching. When considering the strongest evidence for improving objective outcomes, initiatives featuring collaborative, text-based discussion seem most effective. Examples of such activities include case-based discussion, SoMe journal clubs, poll-based quizzing and smaller, near-peer communities of practice. Existing studies suggest that instant messaging services such as WeChat and WhatsApp are most likely to provide intensive dialogue to facilitate learning. Perhaps unsurprisingly, students who engage more with SoMe comments perform best in objective assessments.

This review may inform educators in navigating SoMe professionalism concerns. Despite feeling that professionalism guidelines are poorly understood, the evidence presents a clear picture of a learner population motivated to champion professional practice on SoMe. Students appreciate professionalism in teaching, quickly respond to constructive criticism on SoMe privacy and even seek out professional development opportunities on platforms. In terms of practical guidance, it is clear that fear of appearing unprofessional in front of peers or patients can hamper engagement with SoMe initiatives. Therefore, the use of closed groups may provide reassurance to both educator and learner.

This review has a number of implications for the direction of future research. As detailed above, the community should prioritise undertaking fewer, higher quality studies, rather than the current high output of methodologically weak research. The quality of the current evidence base should provide a roadmap for this work. Considering this review's quantitative studies, the majority of the highest quality articles (MERSQI 12-14, n = 12) investigated outcomes related to blended learning (9/12, 75%), compared to one each on professionalism, reflection and the humanities. Conversely, the lowest quality studies (MERSQI 5-7, n = 20) featured a majority of these latter categories. Professionalism (7/20) was particularly poorly investigated whilst SoMe use in the humanities represented three of the four lowest scored studies in this review.

Interestingly, this pattern was inverted in the review's qualitative studies. Half of the top 10 highest SRQR scores (12-16), including the top two studies, focus on professionalism. This is perhaps an indication that investigating professionalism should be the domain of richer, in-depth qualitative research.

Whilst understanding professionalism was a key tenet of numerous papers in this review, how this is explored should be carefully considered. A recent study of unprofessional behaviour amongst vascular surgery trainees was retracted after a surge of concerns were raised by the medical community.[144] Such complaints focussed on the 'shaming' of professionals, particularly females,[145] and the invasive, covert methods applied by the authors

to investigate unprofessionalism. It should be highlighted that our review includes three papers that systematically searched for participant profiles, collected or reviewed personal data including photographs and made subjective judgements regarding their professionalism.[52,96,131] Such methods are at high risk of researcher prejudice and there remains no validated tool to measure SoMe professionalism. We would suggest that future researchers maintain their own professional and ethical standards by avoiding invasive, subjective judgements and instead pursue higher quality methods of investigating such a complex phenomenon. This review serves as a reminder to educators that despite regulator guidance and much research, there is limited consensus on SoMe professionalism.

Considering the widespread perceived concerns regarding SoMe professionalism and associated guidelines, particularly given the proven hindrance such fears have upon learner engagement, we suggest that the next step for SoMe research lies in this domain. We call for a rigorous investigation to build a community consensus on SoMe professionalism.

We must also urgently reflect on how we undertake research in this field. Whilst we have examined research encompassing a diverse range of rapidly emerging platforms, we suggest a reactionary approach to SoMe research is inappropriate. Future work should focus instead on the common factors across the spectrum of social media in order to address the significant gaps raised by this review. Specifically, we recommend the study of the impact of a range of SoMe platforms upon long-term knowledge retention, largely absent from the current literature. Additionally, a robust assessment of measures to prevent the SoMe harms highlighted in this review is essential.

When considering commonalities between platforms, one must consider the underpinning theory on SoMe. SoMe platforms have their functional differences but educationally the principles are the same: these are rapid, often short-lived[6] communities of practice[11] built on complex socially constructed values,[146] which themselves fluctuate across locations and generations.[107] Brief community lifespan perhaps explains why long-term outcomes have so far proven challenging to establish. The ever-changing norms of communities and tensions between clinical environments and online spaces may contribute to a difficulty in defining SoMe professionalism.

Moreover, placing our results in the context of theoretical principles may advance deeper thinking on SoMe in health professions education. That objective performance benefit is driven by rapid peer-led dialogue highlights the primacy of the community of practice in effective SoMe interventions. Community of practice as a theoretical construct underpinned the majority of the most effective interventions in this review and has been at the focus of rigorous investigations on enhancing knowledge translation in wider healthcare education.[147] Connectivism, whilst a theory literally established for the online environment,[15] is largely knowledge-centred rather than community-focussed. Community appears to dominate social media educational practice, shaping both effective and ineffective learning cultures. This suggests that communities of practice are a more coherent and informative theoretical construct than connectivism in explaining effectiveness in social media education.

5 | CONCLUSIONS

Despite an explosion of research surrounding social media in medical education, understanding this social phenomenon has not significantly progressed in almost a decade. We have established that social media is enjoyable for students, may improve short term knowledge retention and can aid communication between learners and educators. However, students and educators alike remain wary of professionalism concerns and warnings against potential SoMe harms remain.

We suggest that rather than attempting to undertake a superficial evaluation of the latest SoMe trend, the community should instead consider longer-term, higher quality research, rooted in the underpinning educational theories which unite these diverse platforms.

ACKNOWLEDGEMENTS

None.

CONFLICT OF INTEREST

We have no declarations of interest to declare.

AUTHOR CONTRIBUTIONS

JG designed the study, extracted data, synthesised the results and contributed to writing the first draft of the manuscript and subsequent drafts. MU extracted data, synthesised results, and contributed to all drafts of the manuscript. AA extracted data, synthesised results, and contributed to all drafts of the manuscript. OB extracted data, synthesised results, and contributed to all drafts of the manuscript. AO extracted data, synthesised results, and contributed to all drafts of the manuscript. TC extracted data, synthesised results, and contributed to all drafts of the manuscript. ELR designed the study, extracted data, synthesised the results and contributed to writing the first draft of the manuscript and subsequent drafts. All authors approve of the final manuscript for submission.

ETHICAL APPROVAL

Ethical approval not sought as this is secondary research not involving human participants.

ORCID

Jonathan Guckian https://orcid.org/0000-0002-8162-1583
Mrudula Utukuri https://orcid.org/0000-0003-1510-469X
Aqua Asif https://orcid.org/0000-0003-3233-7428
Oliver Burton https://orcid.org/0000-0003-3569-069X
Joshua Adeyoju https://orcid.org/0000-0001-5003-6990
Adam Oumeziane https://orcid.org/0000-0003-2111-6996
Timothy Chu https://orcid.org/0000-0003-4579-1136
Eliot L. Rees https://orcid.org/0000-0002-6458-5808

REFERENCES

1. Statista. Topic: Social Media. Published 2020. https://www.statista.com/topics/1164/social-networks/. Accessed June 13, 2020
2. Mander J. Internet users have average of 7 social accounts. Globalwebindex.
3. Data.worldbank.org. Population, total – China. Published 2020. https://data.worldbank.org/indicator/SP.POP.TOTL?locations=CN. Accessed June 13, 2020
4. McGee JB, Kanter SL. How we develop and sustain innovation in medical education technology: Keys to success. *Med Teach*. 2011;33(4):279-285. https://doi.org/10.3109/0142159X.2011.540264
5. Asch DA, Weinstein DF. Innovation in medical education. *N Engl J Med*. 2014;371(9):794-795. https://doi.org/10.1056/NEJMp1407463
6. Guckian J, Spencer J. #SixSecondStudying: the rise and fall of Vine in MedEd. *Clin Teach*. 2019;16(2):164-166. https://doi.org/10.1111/tct.12913
7. Kaczmarczyk JM, Chuang A, Dugoff L, et al. e-Professionalism: a new frontier in medical education. *Teach Learn Med*. 2013;25(2):165-170. https://doi.org/10.1080/10401334.2013.770741
8. Cole D, Rengasamy E, Batchelor S, Pope C, Riley S, Cunningham AM. Using social media to support small group learning. *BMC Med Educ*. 2017;17(1):1-7. https://doi.org/10.1186/s12909-017-1060-7
9. Stawarz K, Preist C, Coyle D. Use of smartphone apps, social media, and web-based resources to support mental health and well-being: Online survey. *J Med Internet Res*. 2019;21(7):1-14. https://doi.org/10.2196/12546
10. Chong JY, Ching AH, Renganathan Y, et al. Enhancing mentoring experiences through e-mentoring: a systematic scoping review of e-mentoring programs between 2000 and 2017. *Adv Health Sci Educ*. 2020;25(1):195-226. https://doi.org/10.1007/s10459-019-09883-8
11. McLoughlin C, Patel KD, O'Callaghan T, Reeves S. The use of virtual communities of practice to improve interprofessional collaboration and education: findings from an integrated review. *J Interprof Care*. 2018;32(2):136-142. https://doi.org/10.1080/13561820.2017.1377692
12. Kung JW, Eisenberg RL, Slanetz PJ. Reflective practice as a tool to teach digital professionalism. *Acad Radiol*. 2012;19(11):1408-1414. https://doi.org/10.1016/j.acra.2012.08.008
13. Djuricich AM, Zee-Cheng JE. Live tweeting in medicine: "Tweeting the meeting". *Int Rev Psychiatry*. 2015;27(2):133-139. https://doi.org/10.3109/09540261.2014.1000270
14. Raiman L, Antbring R, Mahmood A. WhatsApp messenger as a tool to supplement medical education for medical students on clinical attachment. *BMC Med Educ*. 2017;17(1):1-9. https://doi.org/10.1186/s12909-017-0855-x
15. Goldie JGS. Connectivism: a knowledge learning theory for the digital age? *Med Teach*. 2016;38(10):1064-1069. https://doi.org/10.3109/0142159X.2016.1173661
16. AlFaris E, Irfan F, Ponnamperuma G, et al. The pattern of social media use and its association with academic performance among medical students. *Med Teach*. 2018;40(suppl. 1):S77-S82. https://doi.org/10.1080/0142159X.2018.1465536
17. Cheston CC, Flickinger TE, Chisolm MS. Social media use in medical education: a systematic review. *Acad Med*. 2013;88(6):893-901. https://doi.org/10.1097/ACM.0b013e31828ffc23
18. Whyte W, Hennessy C. Social Media use within medical education: a systematic review to develop a pilot questionnaire on how social media can be best used at BSMS. *MedEdPublish*. 2017;6(2):1-36. https://doi.org/10.15694/mep.2017.000083
19. Sutherland S, Jalali A. Social media as an open-learning resource in medical education: current perspectives. *Adv Med Educ Pract*. 2017;8:369-375. https://doi.org/10.2147/amep.s112594
20. Rose S. Medical student education in the time of COVID-19. *JAMA*. 2020;323(21):2131-2132. https://doi.org/10.1001/jama.2020.5227
21. Goh P-S, Sandars J. A vision of the use of technology in medical education after the COVID-19 pandemic. *MedEdPublish*. 2020;9(1):1-8. https://doi.org/10.15694/mep.2020.000049.1
22. Merchant RM, Lurie N. Social media and emergency preparedness in response to novel coronavirus. *JAMA*. 2020;323(20):2011-2012. https://doi.org/10.1001/jama.2020.4469
23. Gordon M, Gibbs T. STORIES statement: publication standards for healthcare education evidence synthesis. *BMC Med*. 2014;12(1):1-9. https://doi.org/10.1186/s12916-014-0143-0
24. Chan TM, Dzara K, Dimeo SP, Bhalerao A, Maggio LA. Social media in knowledge translation and education for physicians and trainees: a scoping review. *Perspect Med Educ*. 2020;9(1):20-30. https://doi.org/10.1007/s40037-019-00542-7
25. Hammick M, Dornan T, Steinert Y. Conducting a best evidence systematic review. Part 1: from idea to data coding. BEME Guide No. 13. *Med Teach*. 2010;32(1):3-15. https://doi.org/10.3109/01421590903414245
26. Cook DA, Levinson AJ, Garside S. Method and reporting quality in health professions education research: a systematic review. *Med Educ*. 2011;45(3):227-238. https://doi.org/10.1111/j.1365-2923.2010.03890.x
27. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. *Acad Med*. 2014;89(9):1245-1251. https://doi.org/10.1097/ACM.0000000000000388
28. Gordon M, Patricio M, Horne L, et al. Developments in medical education in response to the COVID-19 pandemic: a rapid BEME systematic review: BEME Guide No. 63. *Med Teach*. 2020;42(11):1202-1215. https://doi.org/10.1080/0142159X.2020.1807484
29. Popay J, Roberts H, Sowden A, et al. *Guidance on the Conduct of Narrative Synthesis in Systematic Reviews*. 2006.
30. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J*. 2009;26(2):91-108. https://doi.org/10.1111/j.1471-1842.2009.00848.x
31. Pope C, Mays N, Popay J. *Synthesizing Qualitative and Quantitative Health Evidence: A Guide to Methods*. Maidenhead, UK: Open University Press; 2007.
32. Jurivich DA, Bande D, Theige D, et al. Integrating geriatrics knowledge into a medical student clerkship using Twitter poll. *J Am Geriatr Soc*. 2018;66(12):2389-2393. https://doi.org/10.1111/jgs.15633
33. Khan AA, Siddiqui AZ, Mohsin SF, Al momani MM, Mirza EH. Impact of network aided platforms as educational tools on academic performance and attitude of pharmacology students. *Pakistan J Med Sci*. 2017;33(6):1473-1478. https://doi.org/10.12669/pjms.336.13290
34. Nair GG, Simi S. Does blended learning* techniques using WhatsApp result in better performance by V th semester MBBS students in pathology as compared with lecture classes** alone? *J Educ Technol Heal Sci*. 2018;5(1):57-63. https://doi.org/10.18231/2393-8005.2018.0011
35. Dyavarisgetty PV, Patil DC. An interventional study to assess the effectiveness of "WhatsApp" as a teaching learning tool in community medicine. *Int J Commun Med Public Health*. 2017;4(7):2564-2569.
36. Gon S, Rawekar A. 8454–16768-3-PB.pdf. *MVP J Med Sci*. 2017;4:19-25. https://doi.org/10.18311/mvpjms/2017/v4i1/8454
37. Fischer Q, Nhan P, Picard F, Varenne O. Social network as teaching material in medical school: review and perspectives. *Arch Cardiovasc Dis*. 2018;111(2):71-73. https://doi.org/10.1016/j.acvd.2018.01.001

38. Wang J, Gao F, Li J, et al. The usability of WeChat as a mobile and interactive medium in student-centered medical teaching. *Biochem Mol Biol Educ*. 2017;45(5):421-425. https://doi.org/10.1002/bmb.21065
39. Webb AL, Dugan A, Burchett W, et al. Effect of a novel engagement strategy using twitter on test performance. *West J Emerg Med*. 2015;16(6):961-964. https://doi.org/10.5811/westjem.2015.10.28869
40. Mesko B, Győrffy Z, Kollár J. Digital literacy in the medical curriculum: a course with social media tools and gamification. *JMIR Med Educ*. 2015;1(2):e6. https://doi.org/10.2196/mededu.4411
41. Amgad M, Alfaar AS. Integrating Web 2.0 in clinical research education in a developing country. *J Cancer Educ*. 2014;29(3):536-540. https://doi.org/10.1007/s13187-013-0595-5
42. Woratanarat T. Higher satisfaction with ethnographic edutainment using YouTube among medical students in Thailand. *J Educ Eval Health Prof*. 2014;11:13. https://doi.org/10.3352/jeehp.2014.11.13
43. Robichaud P, Hawken S, Beard L, et al. Vaccine-critical videos on YouTube and their impact on medical students' attitudes about seasonal influenza immunization: a pre and post study. *Vaccine*. 2012;30(25):3763-3770. https://doi.org/10.1016/j.vaccine.2012.03.074
44. Rayner S, Marlow G, Leslie SJ. YouTube: a solution to increased dissemination of guidelines? *Med Educ*. 2017;51(5):550-551. https://doi.org/10.1111/medu.13320
45. Brown A, Jauregui J, Ilgen JS, et al. Does the medium matter? Evaluating the depth of reflective writing by medical students on social media compared to the traditional private essay using the REFLECT Rubric. *West J Emerg Med*. 2019;21(1):18-25. https://doi.org/10.5811/westjem.2019.11.44263
46. Dressler JA, Ryder BA, Connolly M, Blais MD, Miner TJ, Harrington DT. "Tweet"-Format writing is an effective tool for medical student reflection. *J Surg Educ*. 2018;75(5):1206-1210. https://doi.org/10.1016/j.jsurg.2018.03.002
47. George DR, Dellasega C. Use of social media in graduate-level medical humanities education: two pilot studies from Penn State College of Medicine. *Med Teach*. 2011;33(8):e429-e434. https://doi.org/10.3109/0142159X.2011.586749
48. Hsieh JG, Kuo LC, Wang YW. Learning medical professionalism–the application of appreciative inquiry and social media. *Med Educ Online*. 2019;24(1):1586507. https://doi.org/10.1080/10872981.2019.1586507
49. Varga-Atkins T, Dangerfield P, Brigden D. Developing professionalism through the use of wikis: a study with first-year undergraduate medical students. *Med Teach*. 2010;32(10):824-829. https://doi.org/10.3109/01421591003686245
50. Duke P, Grosseman S, Novack DH, Rosenzweig S. Preserving third year medical students' empathy and enhancing self-reflection using small group "virtual hangout" technology. *Med Teach*. 2015;37(6):566-571. https://doi.org/10.3109/0142159X.2014.956057
51. Zhang F, Yuen LW, Ding L, Newman IM, Shell DF. Pilot study of a brief WeChat intervention in China to increase students' willingness to assist a flushing student to reduce alcohol use. *J Prev Med Public Heal*. 2018;51(6):320-325. https://doi.org/10.3961/jpmph.18.127
52. Walton JM, White J, Ross S. What's on YOUR Facebook profile? Evaluation of an educational intervention to promote appropriate use of privacy settings by medical students on social networking sites. *Med Educ Online*. 2015;20(1):28708. https://doi.org/10.3402/meo.v20.28708
53. Hatzipanagos S, John B, Chiu Y-LT. The significance of kinship for medical education: reflections on the use of a bespoke social network to support learners' professional identities. *JMIR Med Educ*. 2016;2(1):e1. https://doi.org/10.2196/mededu.4715
54. Gomes AW, Butera G, Chretien KC, Kind T. The development and impact of a social media and professionalism course for medical students. *Teach Learn Med*. 2017;29(3):296-303. https://doi.org/10.1080/10401334.2016.1275971
55. Wagner R, Jalalat S. Utility of a dermatology interest group blog: the impact of medical student interest groups and Web 2.0 tools as educational resources. *Adv Med Educ Pract*. 2014;331:331-–337. https://doi.org/10.2147/amep.s70776
56. Bramstedt KA, Ierna BN, Woodcroft-Brown VK. Using SurveyMonkey® to teach safe social media strategies to medical students in their clinical years. *Commun Med*. 2014;11(2):117-124. https://doi.org/10.1558/cam.v11i2.27556
57. Lie D, Trial J, Schaff P, Wallace R, Elliott D. "being the best we can be": Medical students' reflections on physician responsibility in the social media era. *Acad Med*. 2013;88(2):240-245. https://doi.org/10.1097/ACM.0b013e31827bf5fc
58. McKay M, Sanko JS, Shekhter I, Birnbach DJ. Twitter as a tool to enhance student engagement during an interprofessional patient safety course. *J Interprof Care*. 2014;28(6):565-567. https://doi.org/10.3109/13561820.2014.912618
59. Godfrey S, Nickerson K, Amiel J, Lebwohl B. Development of an online public health curriculum for medical students: the public health commute. *BMC Med Educ*. 2019;19(1):1-5. https://doi.org/10.1186/s12909-019-1734-4
60. Nanda M. Role of WhatsApp in improving learning among medical students. *Int J Med Sci Public Heal*. 2019;8:1. https://doi.org/10.5455/ijmsph.2019.1235401012019
61. Pickering JD, Swinnerton BJ. Exploring the dimensions of medical student engagement with technology-enhanced learning resources and assessing the impact on assessment outcomes. *Anat Sci Educ*. 2019;12(2):117-128. https://doi.org/10.1002/ase.1810
62. Awan ZA, Awan AA, Alshawwa L, Tekian A, Park YS. Assisting the integration of social media in problem-based learning sessions in the Faculty of Medicine at King Abdulaziz University. *Med Teach*. 2018;40(suppl 1):S37-S42. https://doi.org/10.1080/0142159X.2018.1465179
63. Reames BN, Sheetz KH, Englesbe MJ, Waits SA. Evaluating the use of Twitter to enhance the educational experience of a medical school surgery clerkship. *J Surg Educ*. 2016;73(1):73-78. https://doi.org/10.1016/j.jsurg.2015.08.005
64. Jaffar AA. Exploring the use of a Facebook page in anatomy education. *Anat Sci Educ*. 2014;7(3):199-208. https://doi.org/10.1002/ase.1404
65. Jaffar AA. YouTube: an emerging tool in anatomy education. *Anat Sci Educ*. 2012;5(3):158-164. https://doi.org/10.1002/ase.1268
66. Grover S, Garg B, Sood N. Introduction of case-based learning aided by WhatsApp messenger in pathology teaching for medical students. *J Postgrad Med*. 2020;66(1):17-22. https://doi.org/10.4103/jpgm.JPGM_2_19
67. Lasker R, Vicneswararajah N. Using Twitter to teach problem-based learning. *Med Educ*. 2015;49(5):531. https://doi.org/10.1111/medu.12717
68. El Bialy S, Jalali A, Jaffar AA. Integrating Facebook into basic sciences education: a comparison of a faculty-administered Facebook page and group. *Austin J Anat*. 2014;1(3):1-7.
69. Pickering JD, Bickerdike SR. Medical student use of Facebook to support preparation for anatomy assessments. *Anat Sci Educ*. 2017;10(3):205-214. https://doi.org/10.1002/ase.1663
70. George DR, Dellasega C, Whitehead M. Facebook stress management group for Year 1 medical students. *Med Educ*. 2012;46(11):1118. https://doi.org/10.1111/medu.12034
71. George DR, Dreibelbis TD, Aumiller B. Google Docs and SurveyMonkey™: lecture-based active learning tools. *Med Educ*. 2013;47(5):518. https://doi.org/10.1111/medu.12172

72. Henry DS, Wessinger WD, Meena NK, Payakachat N, Gardner JM, Rhee SW. Using a Facebook group to facilitate faculty-student interactions during preclinical medical education: a retrospective survey analysis. *BMC Med Educ*. 2020;20(1):1-10. https://doi.org/10.1186/s12909-020-02003-w
73. Hennessy CM, Kirkpatrick E, Smith CF, Border S. Social media and anatomy education: Using twitter to enhance the student learning experience in anatomy. *Anat Sci Educ*. 2016;9(6):505-515. https://doi.org/10.1002/ase.1610
74. Ekarattanawong S, Thuppia A, Chamod P, Pattharanitima P, Suealek N, Rojpibulstit P. Perception of social networking benefits in the support of a PBL module according to students' performance levels. *J Med Assoc Thail*. 2015;98(1):S77-S83.
75. Pinilla S, Nicolai L, Gradel M, et al. Undergraduate medical students using Facebook as a peer-mentoring platform: a mixed-methods study. *JMIR Med Educ*. 2015;1(2):e12. https://doi.org/10.2196/mededu.5063
76. George DR, Dellasega C, Whitehead MM, Bordon A. Facebook-based stress management resources for first-year medical students: a multi-method evaluation. *Comput Human Behav*. 2013;29(3):559-562. https://doi.org/10.1016/j.chb.2012.12.008
77. Bahner DP, Adkins E, Patel N, Donley C, Nagel R, Kman NE. How we use social media to supplement a novel curriculum in medical education. *Med Teach*. 2012;34(6):439-444. https://doi.org/10.3109/0142159X.2012.668245
78. Keynejad R, Ali FR, Finlayson AET, et al. Telemedicine for peer-to-peer psychiatry learning between U.K. and Somaliland medical students. *Acad Psychiatry*. 2013;37(3):182-186. https://doi.org/10.1176/appi.ap.11080148
79. Guckian J, Leighton J, Frearson R, Delgaty L, Finn G, Matthan J. The Next Generation: how medical students use new Social Media to support their learning. *MedEdPublish*. 2019;8(3):1-15. https://doi.org/10.15694/mep.2019.000227.1
80. Mohanakrishnan K, Jayakumar N, Kasthuri A, Sowmya N, Malaiyan J, Sumathi G. Whatsapp enhances medical education: is it the future? *Int J Med Sci Public Heal*. 2017;6(2):1. https://doi.org/10.5455/ijmsph.2017.02082016622
81. Gm MI, Meerasa SS. The impact of Whatsapp messenger usage on students performance in tertiary institutions in Ghana. *J Educ Pract*. 2016;5(6):157-164. https://doi.org/10.5958/2393-8005.2016.00013.9
82. Maske SS, Kamble PH, Kataria SK, Raichandani L, Dhankar R. Feasibility, effectiveness, and students' attitude toward using WhatsApp in histology teaching and learning. *J Educ Health Promot*. 2018;7(158). https://doi.org/10.4103/jehp.jehp_30_18
83. Kapoor A, Tiwari V, Kapoor A. Teaching undergraduates beyond the classroom: use of WhatsApp. *Indian Pediatr*. 2019;56(11):967-969. https://doi.org/10.1007/s13312-019-1664-6
84. Abbas N, Ojha U. Not just a medical student: delivering medical education through a short video series on social media. *J Med Internet Res*. 2019;21(5):1-6. https://doi.org/10.2196/11971
85. Junhasavasdikul D, Srisangkaew S, Sukhato K, Dellow A. Cartoons on Facebook: a novel medical education tool. *Med Educ*. 2017;51(5):539-540. https://doi.org/10.1111/medu.13312
86. O'Kelly B, McHugh S, McHugh T, Day N, Boyle E, Hill A. Using social media to increase accessibility to online teaching resources. *Ir Med J*. 2015;108(8):249.
87. Ravindran R, Kashyap M, Lilis L, Vivekanantham S, Phoenix G. Evaluation of an online medical teaching forum. *Clin Teach*. 2014;11(4):274-278. https://doi.org/10.1111/tct.12139
88. Shakoori TA, Mahboob U, Strivens J, Willis I. Impact of a social media group page on undergraduate medical physiology learning. *J Coll Physicians Surg Pak*. 2017;27(7):409-413.
89. Banerjee Y, Tambi R, Gholami M, Alsheikh-Ali A, Bayoumi R, Lansberg P. Augmenting Flexnerism via Twitterism: need for integrating social media application in blueprinting pedagogical strategies for undergraduate medical education. *J Med Internet Res*. 2019;21(3):e12403. https://doi.org/10.2196/12403
90. Guraya SY, Almaramhy H, Al-Qahtani MF, Guraya SS, Bouhaimed M, Bilal B. Measuring the extent and nature of use of Social Networking Sites in Medical Education (SNSME) by university students: results of a multi-center study. *Med Educ Online*. 2018;23(1):1505400. https://doi.org/10.1080/10872981.2018.1505400
91. Lahiry S, Choudhury S, Chatterjee S, Hazra A. Impact of social media on academic performance and interpersonal relation: a cross sectional study among students at a tertiary medical center in East India. *J Educ Health Promot*. 2019;8(73):1-6. https://doi.org/10.4103/jehp.jehp
92. Reverón RR. The use of YouTube in learning human anatomy by Venezuelan medical students. *MOJ Anat Physiol*. 2016;2(7):200-203. https://doi.org/10.15406/mojap.2016.02.00075
93. Garner J, O'Sullivan H. Facebook and the professional behaviours of undergraduate medical students. *Clin Teach*. 2010;7(2):112-115. https://doi.org/10.1111/j.1743-498X.2010.00356.x
94. Bickerdike A, O'Deasmhunaigh C, O'Flynn S, O'Tuathaigh C. Learning strategies, study habits and social networking activity of undergraduate medical students. *Int J Med Educ*. 2016;7:230-236. https://doi.org/10.5116/ijme.576f.d074
95. Rapp AK, Healy MG, Charlton ME, Keith JN, Rosenbaum ME, Kapadia MR. YouTube is the most frequently used educational video source for surgical preparation. *J Surg Educ*. 2016;73(6):1072-1076. https://doi.org/10.1016/j.jsurg.2016.04.024
96. Ponce BA, Determann JR, Boohaker HA, Sheppard E, McGwin G, Theiss S. Social networking profiles and professionalism issues in residency applicants: an original study-cohort study. *J Surg Educ*. 2013;70(4):502-507. https://doi.org/10.1016/j.jsurg.2013.02.005
97. Strausburg MB, Djuricich AM, Carlos WG, Bosslet GT. The influence of the residency application process on the online social networking behavior of medical students: a single institutional study. *Acad Med*. 2013;88(11):1707-1712. https://doi.org/10.1097/ACM.0b013e3182a7f36b
98. Rocha PN, De Castro NAA. Opinions of students from a Brazilian medical school regarding online professionalism. *J Gen Intern Med*. 2014;29(5):758-764. https://doi.org/10.1007/s11606-013-2748-y
99. Chretien KC, Goldman EF, Beckman L, Kind T. It's your own risk: Medical students' perspectives on online professionalism. *Acad Med*. 2010;85(10 suppl.):68-71. https://doi.org/10.1097/ACM.0b013e3181ed4778
100. Henning MA, Hawken S, MacDonald J, et al. Exploring educational interventions to facilitate health professional students' professionally safe online presence. *Med Teach*. 2017;39(9):959-966. https://doi.org/10.1080/0142159X.2017.1332363
101. Osman A, Wardle A, Caesar R. Online professionalism and Facebook – falling through the generation gap. *Med Teach*. 2012;34(8):549-556. https://doi.org/10.3109/0142159X.2012.668624
102. Patel PD, Roberts JL, Miller KH, Ziegler C, Ostapchuk M. The responsible use of online social networking: who should mentor medical students. *Teach Learn Med*. 2012;24(4):348-354. https://doi.org/10.1080/10401334.2012.715260
103. Ben-Yakov M, Kayssi A, Bernardo JD, Hicks CM, Devon K. Do emergency physicians and medical students find it unethical to "Look up" their patients on Facebook or Google? *West J*

Emerg Med. 2015;16(2):234-239. https://doi.org/10.5811/westjem.2015.1.24258
104. Bosslet GT, Torke AM, Hickman SE, Terry CL, Helft PR. The patient-doctor relationship and online social networks: results of a national survey. *J Gen Intern Med*. 2011;26(10):1168-1174. https://doi.org/10.1007/s11606-011-1761-2
105. Jha RK, Shah DK, Basnet S, et al. Facebook use and its effects on the life of health science students in a private medical college of Nepal. *BMC Res Notes*. 2016;9(1):1-8. https://doi.org/10.1186/s13104-016-2186-0
106. Avci K, Çelikden SG, Eren S, Aydenizöz D. Assessment of medical students' attitudes on social media use in medicine: a cross-sectional study assessment and evaluation of admissions, knowledge, skills and attitudes. *BMC Med Educ*. 2015;15(1):1-6. https://doi.org/10.1186/s12909-015-0300-y
107. Curtis F, Gillen J. "I don't see myself as a 40-year-old on Facebook": medical students' dilemmas in developing professionalism with social media. *J Furth High Educ*. 2019;43(2):251-262. https://doi.org/10.1080/0309877X.2017.1359503
108. O'Malley D, Barry DS, Rae MG. How much do preclinical medical students utilize the internet to study physiology? *Adv Physiol Educ*. 2019;43(3):383-391. https://doi.org/10.1152/advan.00070.2019
109. El Bialy S, Jalali A. Go where the students are: a comparison of the use of social networking sites between medical students and medical educators. *JMIR Med Educ*. 2015;1(2):e7. https://doi.org/10.2196/mededu.4908
110. Shenouda JEA, Davies BS, Haq I. The role of the smartphone in the transition from medical student to foundation trainee: a qualitative interview and focus group study. *BMC Med Educ*. 2018;18(1):1-10. https://doi.org/10.1186/s12909-018-1279-y
111. Nicolai L, Schmidbauer M, Gradel M, et al. Facebook groups as a powerful and dynamic tool in medical education: Mixed-method study. *J Med Internet Res*. 2017;19(12):e408. https://doi.org/10.2196/jmir.7990
112. George DR, Dellasega C. Social media in medical education: two innovative pilot studies. *Med Educ*. 2011;45(11):1158-1159. https://doi.org/10.1111/j.1365-2923.2011.04124.x
113. El Bialy S, Ayoub AR. The trends of use of social media by medical students. *Educ Med J*. 2017;9(1):59-68. https://doi.org/10.21315/eimj2017.9.1.6
114. Mustafa AG, Taha NR, Alshboul OA, Alsalem M, Malki MI. Using YouTube to learn anatomy: perspectives of Jordanian medical students. *Biomed Res Int*. 2020;2020:1-8. https://doi.org/10.1155/2020/6861416
115. Hartnup B, Dong L, Eisingerich AB. How an environment of stress and social risk shapes student engagement with social media as potential digital learning platforms: qualitative study. *J Med Internet Res*. 2018;20(7):1-12. https://doi.org/10.2196/10069
116. Li TY, Gao X, Wong K, Tse CSK, Chan YY. Learning clinical procedures through internet digital objects: experience of undergraduate students across clinical faculties. *JMIR Med Educ*. 2015;1(1):e1. https://doi.org/10.2196/mededu.3866
117. Alsuraihi AK, Almaqati AS, Abughanim SA, Jastaniah NA. Use of social media in education among medical students in Saudi Arabia. *Korean J Med Educ*. 2016;28(4):343-354. https://doi.org/10.3946/kjme.2016.40
118. Mysko C, Delgaty L. How and why are students using Twitter for #MedEd? Integrating twitter into undergraduate medical education to promote active learning. *Annu Rev Educ Commun Lang Sci*. 2015;12:24-52.
119. Chretien KC, Tuck MG, Simon M, Singh LO, Kind T. A digital ethnography of medical students who use Twitter for professional development. *J Gen Intern Med*. 2015;30(11):1673-1680. https://doi.org/10.1007/s11606-015-3345-z
120. Khamis N, Aljumaiah R, Alhumaid A, et al. Undergraduate medical students' perspectives of skills, uses and preferences of information technology in medical education: a cross-sectional study in a Saudi Medical College. *Med Teach*. 2018;40(suppl. 1):S68-S76. https://doi.org/10.1080/0142159X.2018.1465537
121. Barry DS, Marzouk F, Chulak-Oglu K, Bennett D, Tierney P, O'Keeffe GW. Anatomy education for the YouTube generation. *Anat Sci Educ*. 2016;9(1):90-96. https://doi.org/10.1002/ase.1550
122. Ali A. Medical students' use of Facebook for educational purposes. *Perspect Med Educ*. 2016;5(3):163-169. https://doi.org/10.1007/s40037-016-0273-5
123. Javed MW, Bhatti R. Usage of social media by medical and dental students at Nishtar Medical College, Multan, Pakistan. *J Hosp Librariansh*. 2015;15(1):53-64. https://doi.org/10.1080/15323269.2015.982031
124. Zanon M, Altmayer S, Pacini GS, et al. Facebook as a tool to promote radiology education: expanding from a local community of medical students to all of South America. *Radiol Bras*. 2018;51(4):242-247. https://doi.org/10.1590/0100-3984.2017.0112
125. Kang J, Djafari Marbini H, Patel P, Fawcett N, Leaver L. Survey of medical students' use of social media. *Clin Teach*. 2015;12(6):373-377. https://doi.org/10.1111/tct.12320
126. Alahmar A. The impact of social media on the academic performance of second year medical students at College of Medicine, University of Babylon, Iraq. *J Med Allied Sci*. 2016;6(2):77. https://doi.org/10.5455/jmas.236927
127. Sarbaz M, Banaye Yazdipour A, Kimiafar K. Use of social networks for learning purposes among medical and paramedical sciences students, Mashhad, Iran. *Stud Health Technol Inform*. 2019;258:105-109. https://doi.org/10.3233/978-1-61499-959-1-105
128. Lee K-L, Ho M-J. Online social networking versus medical professionalism. *Med Educ*. 2011;45(5):523. https://doi.org/10.1111/j.1365-2923.2011.03978.x
129. Jain A, Petty EM, Jaber RM, et al. What is appropriate to post on social media? Ratings from students, faculty members and the public. *Med Educ*. 2014;48(2):157-169. https://doi.org/10.1111/medu.12282
130. Chester AN, Walthert SE, Gallagher SJ, Anderson LC, Stitely ML. Patient-targeted Googling and social media: a cross-sectional study of senior medical students. *BMC Med Ethics*. 2017;18(1):1-8. https://doi.org/10.1186/s12910-017-0230-9
131. Golden JB, Sweeny L, Bush B, Carroll WR. Social networking and professionalism in otolaryngology residency applicants. *Laryngoscope*. 2012;122(7):1493-1496. https://doi.org/10.1002/lary.23388
132. Barlow CJ, Morrison S, Stephens HON, Jenkins E, Bailey MJ, Pilcher D. Unprofessional behaviour on social media by medical students. *Med J Aust*. 2015;203(11):1.e1-1.e7. https://doi.org/10.5694/mja15.00272
133. George DR, Green MJ, Navarro AM, Stazyk KK, Clark MA. Medical student views on the use of Facebook profile screening by residency admissions committees. *Postgrad Med J*. 2014;90(1063):251-253. https://doi.org/10.1136/postgradmedj-2013-132336
134. O'Sullivan E, Cutts E, Kavikondala S, et al. Social media in health science education: an international survey. *JMIR Med Educ*. 2017;3(1):e1. https://doi.org/10.2196/mededu.6304
135. White J, Kirwan P, Lai K, Walton J, Ross S. "Have you seen what is on Facebook?" the use of social networking software by healthcare professions students. *BMJ Open*. 2013;3(7):1-8. https://doi.org/10.1136/bmjopen-2013-003013
136. Hatch T, Bates H, Khera S, Walton J. Professionalism and social media: an interprofessional learning activity. *Med Educ*. 2013;47(11):1136-1137. https://doi.org/10.1111/medu.12334
137. Kitsis EA, Milan FB, Cohen HW, et al. Who's misbehaving? Perceptions of unprofessional social media use by medical

students and faculty. *BMC Med Educ*. 2016;16(1):1-7. https://doi.org/10.1186/s12909-016-0572-x
138. Alkhalaf AM, Tekian A, Park YS. The impact of WhatsApp use on academic achievement among Saudi medical students. *Med Teach*. 2018;40(suppl. 1):S10-S14. https://doi.org/10.1080/0142159X.2018.1464652
139. Al-Dubai SAR, Ganasegeran K, Al-Shagga MAM, Yadav H, Arokiasamy JT. Adverse health effects and unhealthy behaviors among medical students using Facebook. *Sci World J*. 2013;2013:1-5. https://doi.org/10.1155/2013/465161
140. Barman L, Mukhopadhyay DK, Bandyopadhyay GK. Use of social networking site and mental disorders among medical studens in Kolkata, West Bengal. *Indian J Psychiatry*. 2018;60(3):34-345.
141. Tirukkovalluri SS, Malarvannan K, Karthik RC, Mahendiran BS, Arumugam B. An observational exploration of factors affecting perceived social isolation among social media using medical professional course students in South Indian state of India. *Indian J Community Heal*. 2020;32(1):76-81.
142. Sterling M, Leung P, Wright D, Bishop TF. The use of social media in graduate medical education: a systematic review. *Acad Med*. 2017;92(7):1043-1056. https://doi.org/10.1097/ACM.0000000000001617
143. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32- item checklist for interviews and focus group. *Int J Qual Heal Care*. 2007;19(6):349-357. https://doi.org/10.1093/intqhc/mzm042
144. Hardouin S, Cheng TW, Mitchell EL, et al. Prevalence of unprofessional social media content among young vascular surgeons. *J Vasc Surg*. 2020;72(2):667-671. https://doi.org/10.1016/j.jvs.2019.10.069
145. Stamp N, Mitchell R, Fleming S, et al. Social media and professionalism among surgeons: who decides what's right and what's wrong? *J Vasc Surg*. 2020;72(5):1824-1826. https://doi.org/10.1016/j.jvs.2020.07.076
146. Flynn LV, Jalali A, Moreau KA. Learning theory and its application to the use of social media in medical education. *Postgrad Med J*. 2015;91(1080):556-560. https://doi.org/10.1136/postgradmedj-2015-133358
147. Stewart SA, Abidi SSR. Applying social network analysis to understand the knowledge sharing behaviour of practitioners in a clinical online discussion forum. *J Med Internet Res*. 2012;14(6):e170. https://doi.org/10.2196/jmir.1982

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Guckian J, Utukuri M, Asif A, et al. Social media in undergraduate medical education: A systematic review. *Med Educ*. 2021;55(11):1227–1241. https://doi.org/10.1111/medu.14567