



## WASP (Write a Scientific Paper): A review on the online medical resources available for medical training



Sarah Cuschieri

Anatomy Department, University of Malta, Msida, Malta

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### ABSTRACT

The global contemporary shift from paper-based to digital online resources has led to a revolutionary change in medical training. A multitude of online resources have been developed over the years that complement the medical professional's education, with greater access to knowledge, while enabling continuous medical education and development. These sources also allow us to keep up-to-date with medical news. The development of medical mobile applications (apps) has also facilitated medical training by providing versatility, flexibility and portability of updated medical resources.

### 1. Introduction

The medical profession is a journey that one embarks on, commencing in the early years as an undergraduate student, and only terminates with one's passing away. Continuous medical training and keeping up-to-date is a crucial expedient for the medical profession. In the early 2000's, there was a global shift from paper-based to digital online resources [1]. The revolutionarily change with a plethora of online resources inevitably affected medical training, with enhanced digital learning and teaching. Online education emerged, and this is nowadays a common modality that permits learning flexibility, while facilitating collaboration between faculties, universities and students. The old methods of borrowing or buying medical books and languishing in the library to browse through papers are not unsustainable. There are a multitude of online resources that can be utilized for medical training. The following sections will provide a summarized guide to these resources.

### 2. Freely available on-line resources

The World Wide Web hosts a plethora of online resources that contribute to medical training for students and professionals alike. There are also various websites that provide medical information to the general public. Unfortunately, the many online health resources available may not always present accurate information, or the information provided may be misleading, so it is crucial that sources are scrutinized and only trustworthy resources are utilized. It is suggested that one follows the “Who?; What?; When?; Where? and Why?” five-question approach when visiting a health-related online resource in order to

establish its medical validity [2]. Establishing the “Who?” runs the website and whether the source is trustworthy, is the first step. If the source is from a well renowned institution or organization or governmental department, then data can be trusted. Assessing the “What?” the source is claiming and whether it seems to be too good to be true, is the next step to perform, followed by “When” was the information posted. With the continuous evolution of medical techniques and findings, old posts may no longer be valid; therefore it is important that medical sources that one intends to utilize are up-to-date. The next observation should be focused on the “Where?” the information originated from. Online data based on scientific research with links to the published articles offers sound knowledge as compared to data without a known source. Lastly it is wise to establish the “Why?” the online resource exists. If the resource is part of an institution or organization of online resources or outreach, then the objective for the data availability is for learning purposes and not for alternative motive/s, and can therefore be trusted [2].

#### 2.1. Online reviews

A number of online websites provide evidence-based health reviews aimed for medical students, health professionals and the general public. Well-established medical review articles proposed for medical professionals can be accessed from Medscape (<https://emedicine.medscape.com>) while WebMD (<https://www.webmd.com>) is mostly aimed for non-professionals.

Some national and local organisations websites provide specialized online reviews and research aimed mostly for the general public, but this can be useful for medical professionals as well. An example of such

E-mail address: [sarah.cuschieri@um.edu.mt](mailto:sarah.cuschieri@um.edu.mt).

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an organization is Diabetes UK (<https://www.diabetes.org.uk/home>), which provides a conglomerate of diabetes mellitus data, with the aim of enhancing knowledge and education on the topic. Similarly, well-established institutions such as the Mayo Clinic (<https://www.mayoclinic.org>) and Cleveland Clinic (<http://my.clevelandclinic.org>) provide useful information on a number of medical conditions and articles aimed for the general public. Such information may act as a publicity measure for their clinics.

## 2.2. Online media resources

There are a number of online media resources that complement medical training especially when it comes to understanding certain concepts on one's own.

### 2.3. YouTube®

YouTube® is a popular media resource for medical students and professionals. This is a Google subsidiary that hosts a number of free videos that are shared between users. Users are able to upload, view, rate, share and add to their favourite lists, videos on all genera including medicine. It is important that users are able to identify reliable video sources before using any of these media for their medical training. One of the functions of YouTube® is the hosting of channels by a number of sources including Universities (e.g. Harvard Medical School) and educational centres (e.g. Oxford Medical Education). Such channels provide reliable videos that cover a number of medical concepts and aspects including examination techniques and much more. To enhance the utilization of YouTube, this video-sharing platform has been modified to accommodate mobile usage through a downloadable application on any type of smartphone operating system.

### 2.4. Podcasts

Podcasts are emerging multimedia online resources that have been reported to give a new dimension to continuous medical professional development [3]. These casts are usually audio files but video podcasts are also being produced. These are downloaded from the Internet onto computers or portable media devices and are played on-demand, which suits the hectic lifestyle of typical medical professionals, especially those working on a shift basis. Furthermore, since podcasts can be downloaded on portable devices, they provide easy access for commuters on their way to their workplace or on their return back home [3]. It is important that the user downloads updated podcasts in order to have the latest available versions. There are a number of medical related podcasts that are easily downloadable provided by universities (e.g.: Harvard Medical School), medical centres (e.g. John Hopkins Medicine) and journals (e.g. the British Medical Journal – BMJ).

### 2.5. RSS (Really Simple Syndication)

This type web feed is an automatically updated collection of data sources that is composed of blogs, news sites, audio and video channels. This can be accessed through a web- or desktop- or mobile device-based software entitled RSS feeds [4].

## 3. Online networks

With the advancement of the technology era it came as no surprise that as time passed, different online networks developed. These easily accessible online networks can be used for various reasons, one of which is the sharing of medical knowledge and data between users.

### 3.1. Academic networks

There are currently two established academic networks available,

namely ResearchGate.net (<https://www.researchgate.net>) and Academia.edu (<https://www.academia.edu>). These networks enable medical professionals to share their academic and research output, provided there are no copyright restrictions. These networks can be used as research databases to identify work conducted by a particular author as well as follow their research work.

### 3.2. Social media and networks

Social media has become a popular means of communication, with social networks, gaining global popularity by millions of people (from young kids to elderly). These can be accessed either through a computer or laptop as well as through mobile applications.

### 3.3. Facebook

Facebook (<http://www.facebook.com>) is a popular social network founded in 2004 by Mark Zuckerberg that has now spread worldwide [5]. Over the years, Facebook has evolved and can be used as a means of medical training. Members can create 'Facebook groups' between a number of individuals to facilitate sharing of information, data and opinions through the uploading of documents, media as well as online chatting simultaneously. Facebook can also be used to transmit live videoconferences on Facebook pages, which enhances the distribution of medical data between all those subscribed to that Facebook page irrelevant of their place of origin.

### 3.4. Google +

Google + (<http://plus.google.com>) is another community-based site, which was launched in 2011. It consists of the same online services of Google but can incorporate a group of users into 'Circles', which are created and defined by the users themselves. Post submitted on these circles can be shared with anyone (public) or with specific users or circles. These communities can discuss medical topics and share data between themselves. The service is further enhanced by 'Google Hangouts', which facilitates video chats between Google+ users [6].

### 3.5. Twitter

Twitter is a well-known social network (<http://twitter.com>), which originated in 2006 by Jack Dorsey as an SMS-based communication platform and has now evolved to sharing of tweets and following tweets from all around the globe [7]. A Twitter member is able to follow individuals, universities, institutions and clinics 'tweets' while sharing or commenting on that particular tweet. This is a good means to keep updated with newly published medical work or research that is tweeted by medical journals or other reliable sources.

### 3.6. LinkedIn

LinkedIn (<http://www.linkedin.com>) is another social network that was created in 2003 to connect different professionals and build trust among users. This site is used to upload personal information including education, experience, skills, awards, workplaces, interests and recommendations, through which medical professionals can make contact and extend their networking. Sound professional networking enhances medical training and knowledge between professionals [6].

## 4. Scholarly online resources and courses

It is common practice for universities to provide online education, courses and resources for their students and academics, through the use of online platforms. This modality has become popular through its ability to connect students to academics and peers, and the course content by means of a flexible and asynchronous environment [8]. In

fact, both the academic staff and the students benefit from the “anytime and anywhere” approach to learning and working. This permits the student to acquire one of the *21st century skills*, where the student needs to display self-reliance and learn content without the face-to-face instructions provided in the traditional classroom, as well as the need to keep track with weekly assignments through the use of virtual platforms [8].

These scholarly online courses exhibit a revolutionary approach to the increasing demanding era of continuing medical education (CME) and continuous professional development (CPD) faced by medical professionals [9]. It may be challenging for medical professionals to attain their medical training while having a multitude of commitments which prohibit them from attending conferences, courses or engaging in on-site postgraduate education. Nowadays, these challenges have been attenuated through online CME and CPD courses, as well as distance learning education.

Distance learning modules, diplomas, masters and doctoral studies (PhD) are being offered by a number of Universities through online learning. Some of these courses are solely online and some adopt a blended format, where lectures and coursework are provided virtually, but exams and sometimes workshops are supplemented by face-to-face formats. Such online courses utilize a virtual learning environment (VLE) where coursework, presentations and media are distributed to the students by academics. Some universities (e.g. University of Malta and University of York) also use this VLE system as a means of providing coursework for those attending traditional classroom courses.

Online learning has been criticized for the dissociative process and disconnect between the academic and the students. However this has been overcome with the emergence of ‘connectivism’, which is a principle developed by Siemens, where individual ideas, opinions, perspective diversity, learning, formulation of relationships and interdisciplinary connections are considered together through daily technology [10]. These daily technologies include Wikis, Facebook, YouTube etc. Furthermore, as part of online courses, discussion forums and real-time video conferencing have also been developed. Discussion forums are used for networking and for the creation of interactions between students and their peers, as well between students and the academics [8].

#### 4.1. Transmission of events

With the advancement of technology and Internet utilities, it has become feasible for the transmissions of live conferences or courses from one institution/country to another. This technology is utilized by the postgraduate medical training of Malta with online lectures and tutorials from tertiary centres in the United Kingdom [11].

#### 4.2. Institutional depositories (IR)

Most institutes, including universities, have created a virtual repository where academics, researchers and students archive their work online. These repositories collect, preserve and disseminate the intellectual output of their institute/university as well as provide a means of showcasing and enhancing the visibility of the research carried out. The research articles or theses available in these depositories may be restricted by an embargo period, where the full-text may not be readily available immediately. This is also referred to as “Green Open Access” [12].

### 5. Research

It has become a common requirement for both medical students and medical professionals to undertake research as part of their medical training and career progression, with the *publish or perish* adage becoming increasingly apt [13]. There are numerous online resources that can facilitate this requirement. With the transition from paper based to

digital format, it has become easier to track and identify medical resources and research that contrast relevant materials from all around the world. Equipped with adequate keywords and online platforms, it is easy for the medical professional to achieve his/her goal.

#### 5.1. PubMed

The first port of call for most of those performing research is invariably PubMed, which is a free service provided by the United States National Library of Medicine [11,14]. PubMed provides free access to the MEDLINE® database as well as links to full-text articles found in PubMed Central or at a publisher's website. PubMed Central (PMC) is a free archive of life sciences and biomedical journal literature, which is managed by the National Library of Medicine's National Centre for Biotechnology Information (NCBI). A number of journals index their articles on PMC. In return PMC provides permanent storage and access to all of its contents [15].

PubMed facilitates advanced searching, and also offers clinical queries search filters and special queries pages. The search features enables the user to customize the search by Medical Subject Headings (MeSH) terms, author names, title words, text words or phrases and journal names [14]. Journals featured on MEDLINE® through PubMed database would have undergone thorough review and scoring system and only journals contributing high scientific quality papers manage to become indexed in this database [16]. Therefore articles and journals retrieved through PubMed database can be considered reliable and can be cited confidently.

#### 5.2. Google scholar

Google scholar is a simple search engine that uses the same search function as Google but accesses peer-reviewed papers, theses, abstracts, books and articles extracted from an academic's publishers' sites, universities, professional societies, preprint repositories and other organisations [17]. Google Scholar has also been reported to be able to access gray literature [11,18].

Google scholar is an easy tool due to our familiarity with Google [19]. However, compared with PubMed there are a number of shortcomings including lack of advanced search features and lack of controlled vocabulary, among others [19]. It has been documented that when researching for health related topics, such as patient care information, clinical trials and literature review one should not solely consider the Google Scholar database [20,21].

### 6. Medical wikis

A wiki is a web page or a collection of web pages that serve as a platform for the online sharing of knowledge and collaboration. These enable anyone to modify or contribute to the content found available in the wiki. There are a number of medical wikis that are used by medical professionals as a source of knowledge sharing. Medpedia (<http://www.medpedia.com>) is an open platform launched by a group of medical schools as an alternative to Wikipedia [22]. There are a number of medical wikis available to enhance medical training including: Askdrwiki (<http://askdrwiki.com>) targeted for medical specialists; Radiopaedia (<http://radiopaedia.org>) targeted for radiology; WikiCancer (<http://www.wikicancer.org>) covers the topic of cancer, while WikiKidney (<http://www.wikikidney.org>) covers nephrology [23].

### 7. Mobile apps

The revolutionary advancements in communication, and the creation of smartphones have provided a platform for multimedia and delivery/receiving of data. The development of innovative applications (mobile apps) has provided a plethora of clinical resources in a

convenient and searchable fashion to aid medical professionals in their daily work, clinical practice and continuous medical education (CME) [24–26]. It has been reported that 70% of medical school health care professions as well as students utilize at least one medical app on regular basis [24,26]. Both Apple and Google have App-stores with a medical category through which medical related apps can be downloaded [27,28]. There are a number of different medical related apps available, some of which are free and fully functional while others require a subscription [24].

### 7.1. Literature research and review

A number of medical journals (example: BMJ, The Lancet and New England Journal of Medicine) provide mobile apps to access articles on mobile devices although the majority of these apps do not offer free access [29,30]. There are a number of medical literature search apps that a medical profession can access, among which are PubMed on Tap, PubSearch, MEDLINE Database on Tap and Medscape apps [31].

### 7.2. Medical news and updates

Medical professionals can keep up-to-date with breaking medical news, or categorizing news by interest while acquiring CME credits through the MedPage Today app [29]. There are various other medical news apps available that medical professionals can utilize [29].

### 7.3. Drug reference

Medical drugs information apps are available that provides the user with the drug name, dosage, dose by weight calculators, indications, contraindications, interactions, pharmacology, cost, formulary status and identification guides [31,32]. Examples of such mobile apps include: Epocrates, Skyscape RxDrugs/Omnio and FDA Drugs [31,33].

### 7.4. Clinical decision-making

Applications providing rapid access to evidence-based information that support clinical decision-making at point of care are available. Some examples of such apps include: 5-Minute Clinical Consult (5MCC), Pocket Medicine Infectious Diseases (PMID) and John Hopkins Antibiotic Guide (JHABx) [30,31,33]. Some mobile apps can be used for simple examinations for colour blindness or visual acuity, blood pressure or glucose levels [29–32]. The app iMurmur is composed of 20 types of heart murmurs recordings that allows the medical professional to identify and match what he or she is hearing [30,32]. There are also apps that establish pregnancy due dates by utilizing the patient's date of last period and sonograms, e.g. Perfect OB Wheel [30,32]. A number of risk scores and calculator apps have also been developed such a calculators for body mass index (BMI), proper drug dosage such as MedCalc and calculators for heart disease and stroke risks such as QxMD [30,31].

### 7.5. Medical training

Mobile applications can also be used by health care students to log in their experience through online logbooks, take basic notes, access quick medical information, access online textbooks and lectures, medical podcasts as well as undergo simulation training [26,30,34].

## 8. Conclusion

The World Wide Web era has revolutionized medical training with a shift from paper based and library to an online and virtual learning epoch. The myriad online resources enable the medical professional to continue his/her training and education with convenience, and permits access to up-to-date resources at point-of-care. Social networks have

enhanced communication and the sharing of data between groups of professionals. The development of smartphones has augmented communication between professionals as well as accessibility to medical literature, medical news and clinical skills resources at a touch of a button.

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## References

- [1] Andrea Leontiou, Shift from analog to digital is nearly complete - technology & science - innovation | NBC News, [http://www.nbcnews.com/id/41516959/ns/technology\\_and\\_science-innovation/t/worlds-shift-analog-digital-nearly-complete/#.Wgk9u7aZPpA](http://www.nbcnews.com/id/41516959/ns/technology_and_science-innovation/t/worlds-shift-analog-digital-nearly-complete/#.Wgk9u7aZPpA), Accessed date: 13 November 2017.
- [2] National Centre for Complementary and Integrative Health (NIH), Finding and evaluating online resources | NCCIH, <https://nccih.nih.gov/health/webresources>, Accessed date: 13 November 2017.
- [3] Oliver Large, Charles Hall, Thomas Treibel, BMJ Careers - medical podcasts: the future of continuing professional development? <http://careers.bmj.com/careers/advice/view-article.html?id=2799>, Accessed date: 13 November 2017.
- [4] B. Meskó, Chapter 3 being up-to-date in medicine, Social Media in Clinical Practice, 2013, pp. 27–29, , [https://doi.org/10.1007/978-1-4471-4306-2\\_3](https://doi.org/10.1007/978-1-4471-4306-2_3).
- [5] S. Philips, A brief history of Facebook | Technology | The Guardian, <https://www.theguardian.com/technology/2007/jul/25/media.newmedia>, Accessed date: 15 November 2017.
- [6] B. Meskó, Chapter 4 community sites: Facebook, Google+ and medical social networks, Social Media in Clinical Practice, 2013, pp. 39–48, , [https://doi.org/10.1007/978-1-4471-4306-2\\_4](https://doi.org/10.1007/978-1-4471-4306-2_4).
- [7] Amanda MacArthur, The real history of Twitter, in brief, <https://www.lifewire.com/history-of-twitter-3288854>, Accessed date: 15 November 2017.
- [8] S.A. Reese, Online learning environments in higher education: connectivism vs. dissociation, Educ. Inf. Technol. 20 (3) (2015) 579–588, <https://doi.org/10.1007/s10639-013-9303-7>.
- [9] R.M. Harden, A new vision for distance learning and continuing medical education, J. Contin. Educ. Heal. Prof. 25 (1) (2005) 43–51, <https://doi.org/10.1002/chp.8>.
- [10] George Siemens, Connectivism: a learning theory for the digital age, [http://www.itdl.org/journal/jan\\_05/article01.htm](http://www.itdl.org/journal/jan_05/article01.htm), Accessed date: 13 November 2017.
- [11] V. Grech, A review of resources on the internet which can be utilized for medical training, J. Vis. Commun. Med. 32 (3–4) (2009) 101–104, <https://doi.org/10.3109/17453050903402861>.
- [12] Newcastle University, Green and gold open access, <http://www.ncl.ac.uk/openaccess/green-gold/>, Accessed date: 13 November 2017.
- [13] V. Grech, Publish but do not perish in the open access model, Malta Med. J. 25 (3) (2013) 1.
- [14] US National Library of Medicine, Fact Sheet PubMed: Medline Retrieval on the World Wide Web, (2018).
- [15] PMC overview, <https://www.ncbi.nlm.nih.gov/pmc/about/intro/>, Accessed date: 18 November 2017.
- [16] US National Library of Medicine: NIH, FAQ: journal selection for MEDLINE® indexing at NLM, [https://www.nlm.nih.gov/pubs/factsheets/js\\_sel\\_faq.html](https://www.nlm.nih.gov/pubs/factsheets/js_sel_faq.html), Accessed date: 13 November 2017.
- [17] About Google scholar, <https://scholar.google.com/intl/en/scholar/about.html>, Accessed date: 13 November 2017.
- [18] J. Giles, Science in the web age: start your engines, Nature 438 (7068) (2005) 554–555, <https://doi.org/10.1038/438554a>.
- [19] M. Shultz, Comparing test searches in PubMed and Google scholar, J. Med. Libr. Assoc. 95 (4) (2007) 442–445, <https://doi.org/10.3163/1536-5050.95.4.442>.
- [20] J. Henderson, Google scholar: a source for clinicians? Can. Med. Assoc. J. 172 (12) (2005) 1549–1550, <https://doi.org/10.1503/cmaj.050404>.
- [21] D. Giustini, How Google is changing medicine, BMJ 331 (7531) (2005) 1487–1488, <https://doi.org/10.1136/bmj.331.7531.1487>.
- [22] M.L. Rethlefsen, Medpedia, J. Med. Libr. Assoc. 97 (4) (2009) 325–326, <https://doi.org/10.3163/1536-5050.97.4.024>.
- [23] B. Meskó, Wikipedia and medical wikis, Social Media in Clinical Practice, Springer London, London, 2013, pp. 87–94, , [https://doi.org/10.1007/978-1-4471-4306-2\\_9](https://doi.org/10.1007/978-1-4471-4306-2_9).
- [24] M. Murfin, Know your apps: an evidence-based approach to evaluation of mobile clinical applications, J. Physician Assist. Educ. 24 (3) (2013) 38–40 <http://www.ncbi.nlm.nih.gov/pubmed/24261171> (Accessed November 16, 2017).
- [25] S. Mickan, J.K. Tilson, H. Atherton, N.W. Roberts, C. Heneghan, Evidence of effectiveness of health care professionals using handheld computers: a scoping review of systematic reviews, J. Med. Internet Res. 15 (10) (2013) e212, , <https://doi.org/10.2196/jmir.2530>.

- [26] S. Wallace, M. Clark, J. White, 'It's on my iPhone': attitudes to the use of mobile computing devices in medical education, a mixed-methods study, *BMJ Open* 2 (4) (2012) e001099, <https://doi.org/10.1136/bmjopen-2012-001099>.
- [27] K.F.B. Payne, H. Wharrad, K. Watts, Smartphone and medical related app use among medical students and junior doctors in the United Kingdom (UK): a regional survey, *BMC Med. Inform. Decis. Mak.* 12 (1) (2012) 121, <https://doi.org/10.1186/1472-6947-12-121>.
- [28] T. Lewis, Apple launches dedicated "Apps for Healthcare Professionals" collection, <https://www.imedicalapps.com/2013/02/apple-apps-healthcare-professionals-collection/>, Accessed date: 16 November 2017.
- [29] J.-H. Yoo, The meaning of information technology (IT) mobile devices to me, the infectious disease physician, *Infect. Chemother.* 45 (2) (2013) 244–251, <https://doi.org/10.3947/ic.2013.45.2.244>.
- [30] C.L. Ventola, Mobile devices and apps for health care professionals: uses and benefits, *P T* 39 (5) (2014) 356–364 <http://www.ncbi.nlm.nih.gov/pubmed/24883008> (Accessed November 13, 2017).
- [31] A.S.M. Mosa, I. Yoo, L. Sheets, A systematic review of healthcare applications for smartphones, *BMC Med. Inform. Decis. Mak.* 12 (2012) 67, <https://doi.org/10.1186/1472-6947-12-67>.
- [32] K. Kiser, 25 ways to use your smartphone. Physicians share their favorite uses and apps, *Minn. Med.* 94 (4) (2011) 22–29 <http://www.ncbi.nlm.nih.gov/pubmed/21560878> (Accessed November 17, 2017).
- [33] T.D. Aungst, Medical applications for pharmacists using mobile devices, *Ann. Pharmacother.* 47 (7–8) (2013) 1088–1095, <https://doi.org/10.1345/aph.1S035>.
- [34] K.M. O'Neill, H. Holmer, S.L.M. Greenberg, J.G. Meara, Applying surgical apps: smartphone and tablet apps prove useful in clinical practice, *Bull. Am. Coll. Surg.* 98 (11) (2013) 10–18 <http://www.ncbi.nlm.nih.gov/pubmed/24313133> (Accessed November 17, 2017).
- [35] V. Grech, WASP - write a scientific paper course: why and how, *J. Vis. Commun. Med.* 40 (3) (2017) 130–134.
- [36] V. Grech, S. Cuschieri, Write a scientific paper (WASP) - a career-critical skill, *Early Hum. Dev.* 117 (2018 Feb) 96–97, <https://doi.org/10.1016/j.earlhumdev.2018.01.001>.