The Promise of New Technologies in an Age of New Health Challenges
A.J. Maeder et al. (Eds.)

doi:10.3233/978-1-61499-712-2-82

WhatsApp in Clinical Practice: A Literature Review

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Abstract. Several spontaneous telemedicine services using WhatsApp Messenger have started in South Africa raising issues of confidentiality, data security and storage, record keeping and reporting. This study reviewed the literature on WhatsApp in clinical practice, to determine how it is used, and users' satisfaction. *Methods* Pubmed, Scopus, Science Direct and IEE Expert databases were searched using the search term WhatsApp and Google Scholar using the terms WhatsApp Telemedicine and WhatsApp mHealth. *Results* Thirty-two papers covering 17 disciplines were relevant with the most papers, 12, from India. Seventeen papers reported the use of WhatsApp Groups within departments, 14 of which were surgery related disciplines. Groups improved communication and advice given on patient management. Confidentiality was mentioned in 19 papers and consent in five. Data security was partially addressed in 11 papers with little understanding of how data are transmitted and stored. Telemedicine services outside of departmental groups were reported in seven papers and covered emergency triage in maxillofacial, plastic, neuro and general surgery, and cardiology and telestroke. *Conclusions* WhatsApp is seen to be a simple, cheap and effective means of communication within the clinical health sector and its use will grow. Users have paid little attention to confidentiality, consent and data security. Guidelines for using WhatsApp for telemedicine are required including downloading. WhatsApp messages to computer for integration with electronic medical records.

Keywords. WhatsApp, data security, consent, confidentiality, record keeping

Introduction

Global uptake of telemedicine has been slow, especially in the developing world, where the need is greatest. Barriers to its use in the developing world are the high costs of infrastructure and telecommunication [1] and the extra work required of already overburdened health professionals to participate in a videoconference consultation or to submit patient data for store and forward telemedicine [2]. Governments of poor countries have low tax bases with resultant limited health budgets [3]. They rightly weigh up the opportunity costs of providing either videoconferencing or computer equipment, with associated training, support and maintenance costs, to rural hospitals and clinics for telemedicine. There is little hard economic evidence of the benefits of telemedicine over, for example, provision of mosquito nets, better cold-chain management of vaccines or training of community health workers.

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Much has been written about mHealth and the development and use of mobile phone applications for medicine, surveillance, behaviour change, appointment and treatment reminders and the use of social media apps for support groups and delivery of medical services. The telephone has been a means of communication between patients and doctors and between health professionals since at least 1879. Doctors were quick to realise its potential and Einthoven transmitted ECG's over the telephone in 1906 while others transmitted heart and lung sounds by telephone in the 1910's [4]. The smartphone has introduced a new dimension, functioning as a pager, computer, camera, videoconferencing unit, audio recorder, data storage device and telephone. While much has been published about health specific mobile phone applications, what of the use of apps not intended for healthcare delivery?

Over the past three years we have noted the evolution of spontaneous, unplanned telemedicine services in KwaZulu-Natal, South Africa, using a mobile phone app, WhatsApp, designed for text, voice and image transfer. WhatsApp is a proprietary, free, mobile messaging client for smartphones using Android, iOS and Windows operating systems with support for Blackberry and Nokia operating systems to end in 2016 [5]. It is widely used with over one billion active users in February 2016 [6]. Without the need for expensive videoconferencing equipment or computer networks, doctors in the developing world have found practical use for it in clinical and administrative settings because the service is ubiquitous, free and easy to use. [7, 8].

As with any eHealth clinical service, data security, confidentiality and privacy issues need to be addressed. Data security during transmission of information, its subsequent storage on smartphones, and record keeping of chat messages are serious concerns and the process of data transmission needs to be understood. To send a WhatsApp message, an Internet connection is required, either through a wireless connection or a data connection through the phone eg 3G. The message is routed to a WhatsApp server, which may or may not be in the same country as the sender, and the server attempts to send the message to the recipient. If and when the recipient's smartphone is available i.e. has an Internet connection, the message is forwarded and deleted from the server. If, after one month, the message has not been forwarded it is deleted from the server. Data security during transmission to the server and recipient has long been considered a problem with WhatsApp with reports of programmes to hack into WhatsApp users' accounts. This was resolved in April 2016 and now, when using the most recent version of WhatsApp, all messages including text, images, video, audio and file sent for one to one communication, "chat", or one to many, "chat groups" are end to end encrypted for Android, iOS and Windows operating systems [9].

Such is the level of encryption that it is a problem for security agencies who are not able to access decrypted messages. In Britain, the Prime Minister and MI5 have called for WhatsApp to be banned [10], with similar concerns in India [11]. This year in Brazil, the service was blocked for 72 hours by court order and a Facebook executive was arrested for failing to provide decrypted messages for a drug related court case [12].

In the developing world issues such as confidentiality and data security, while noted, are frequently not adequately regulated. For example, "There are no clear guidelines for patient confidentiality from both the Dental Council and Medical Council of India and as such is less of an issue in India as compared to the developed countries" [13]. With improved encryption WhatsApp is a viable option for clinical

telemedicine services and has the potential to improve telemedicine uptake in the developing world.

The aim of this study was to review current literature on the use of WhatsApp in clinical practice, to determine how it is used, and users' satisfaction.

1. Methods

The following electronic databases and search terms were used, PubMed - WhatsApp[All fields]; Scopus - WhatsApp (All fields); Science Direct - WhatsApp(All fields); IEE Expert - WhatsApp, and Google Scholar - ("WhatsApp" AND "Telemedicine") or ("WhatsApp" AND "mHealth"). The first one hundred hits for the two searches of Google Scholar were reviewed. The search was up to the end of December 2015. Inclusion criteria were that the paper was in English and described the use or potential use of WhatsApp in clinical services. Papers reporting use of WhatsApp solely for education, behaviour change or patient reminders were excluded. Data were extracted on the year of publication, country of origin of the paper, discipline involved, nature of the service reported (clinical telemedicine services, intradisciplinary chat groups, case reports, research projects), perceived advantages and disadvantages of using WhatsApp, consent, confidentiality, data security, encryption and IT Governance.

2. Results

Fifty-eight papers including pre-prints were found from 2013 to 2015, 32 of which met the inclusion criteria. They originated from ten countries India (12 papers) [13-24], UK (5) [25-29], Italy (4) [30-33], Saudi Arabia (3) [34-36], Spain (2) [37, 38], Turkey (2) [39, 40], Brazil (1) [41], Netherlands (1) [7], Philippines (1) [42], USA/South Africa (1) [43]. They were made up of 13 papers, eight letters (three of which were responses to a paper), seven case reports and four abstracts. Disciplines reported were orthopaedic surgery (7) [16-19, 38, 41], surgery (5) [25-28, 31] (three of which were letters in response to a paper) [25-27], maxillofacial surgery (3) [13, 22, 40], plastic surgery (2) [20, 34], urology (2) [29, 42], dermatology (2) [35, 36], cardiology (1) [39], critical care (1) [14], cardiac surgery (1) [32], stroke (1) [24], palliative home care (1) [15], paediatric surgery (1) [43], neurosurgery (1) [30], diabetic retinopathy screening (1) [21], oral medicine (1) [33], allergy (1) [37], and laboratory services (1) [23].

The use of WhatsApp groups for intradisciplinary communication was reported in 17 articles three, of which were letters in response to a paper [25-27], one service was reported twice [18, 19] and one paper reported a survey of dermatologists who were members of different WhatsApp groups [36]. Of the thirteen remaining reports all were in surgical disciplines except for the survey of dermatologists. All of the services were confined to intradepartmental communication across a range of aspects, including second opinion [13, 19, 23, 30, 34], updates of patient admission and changes in treatment plans[13, 16, 19, 28, 30, 31, 34, 38] which also facilitated daily staff handover meetings [16, 30], theatre scheduling [13, 28, 34, 38], sharing of XRays and photographs (on admission and pre and postoperative) [13, 16, 19, 20, 23, 34], scheduling of academic meetings, and sharing of educational materials such as papers

[28, 29, 34]. Five were from India [13, 16, 19, 20, 23], two from the UK [28, 29], two from Italy [30, 31], two from Saudi Arabia [34, 36] and one each from Spain [34, 38] and the Phillipines [42]. Seven of the services reported routine use of WhatsApp for communication with three in India, two in Italy, and one each in Spain and Saudi Arabia [13, 19, 20, 30, 31, 34, 38].

There were seven case reports, six of which were from India and one from Saudi Arabia. Six clinical services other than intradepartmental groups included a diabetic retinopathy screening service in India that used a fundal camera attached to a smartphone [21], a triage service for oral and dental pathology in Italy [33], an afterhours second opinion service for emergency maxillofacial injuries in Turkey [40] an emergency cardiology programme in Turkey [39], and patients in Spain using WhatsApp to contact their allergist [37]. An overview of use of surgical apps in clinical practice mentioned the use of WhatsApp by a paediatric surgeon in South Africa [43].

Eight papers were reported as trials or audits. There were two concordance studies in orthopaedics [41] and urology [42], five audits of the use of intradisciplinary chat groups[16, 18, 28, 29, 34] and a report of the use of WhatsApp for one to one telemedicine referrals to improve time to reperfusion in patients with ST segment elevation myocardial infarcts [39].

Satisfaction with WhatsApp was gauged by perceptions of advantages. Advantages were noted in 11 papers and disadvantages in eight with three papers listing both advantages and disadvantages. (Table 1)

Table 1. Perceived advantages and disadvantages of using WhatsApp.

Advantages	Disadvantages
Improvement over voice only communication [13]	Frequent interruption [16,23]
Less disruptive than a pager [28,29]	Disparity in the sense of urgency [16]
Reduces need to be in hospital [31]	Worsens professional relationships [16]
A computer not required [33,40]	Leads to unprofessional behavior [16]
Faster than email [23,36]	Requires staying online 24 hours a day [19,34]
Permits immediate response [31,35]	Unable to print a record of chat [34,19]
Reduces clinical incidents[30]	Not part of the medical records [34,19]
Ameliorates surgery performance [30]	Difficulty identifying patients in chats [34,19]
Reduces consultation time [30,35]	NHS against instant messaging [26]
Increases level and improves supervision [28]	Possible issues of privacy [31]
Flattens hierarchy[28]	Possible issues of confidentiality [22]
Involves more senior staff in decisions [23,28,29,36]	Cost of device[22]
Encourages junior doctors to seek help [29]	Increased work using WhatsApp [23]
Improves team perception of effectiveness [18]	Risk of reducing autonomy of registrars [28]

Consent was discussed in only five papers. Three were group services [19, 20, 34], one a survey of dermatologists [36] and the other an overview of WhatsApp use [7]. Only three papers reported actually gaining consent for clinical photography [19, 20, 34] with consent for sharing information within a group noted in two [19, 34]. Consent to transmit and share other patient data via WhatsApp was raised in an overview of the use of social media on radiology [7]. A survey of dermatologists involved one or more groups noted that ideally consent should be obtained [36] and an overview paper noted that patients "should be able to provide consent" [7]. Two of the papers reported plastic surgery groups, with one dermatology and one orthopaedic group; all specialties that commonly take clinical photographs [19, 20, 34, 36].

Some papers referred to confidentiality whilst others used privacy, and although they are different they are often erroneously used synonymously. Confidentiality was addressed in 19 papers, nine of which identified this as a challenge or proposed ways of

maintaining confidentiality [7, 13, 15, 22, 23, 27, 31, 36, 44]. In the 10 services that discussed confidentiality, nine were in WhatsApp groups. Actions taken to maintain confidentiality were to: de-identify patients [18]; minimise patient identifiers [16, 29]; use patient's initials [28]; identify patients by ward, bed number, procedure and specialist, by date of surgery and place on the operating list [19, 34, 38]; password protect the phone or phone and WhatsApp [29]; restrict communication to within the group [20]; and 'protected' with no further information given.[41] Another group considered that they maintained privacy by only sending messages to their group over the hospital's secure wireless network or Internet [28, 41]. With messages about multiple patients in a chat group it was noted that it was sometimes difficult to identify to which patient the message referred [34].

Data security was addressed in 11 papers. Concern was raised about data security on the WhatsApp server during its transmission [25] but this has now been resolved with end-to-end encryption. Some felt that data transmission was secure if sent over a wireless network and would be more secure if access to the network was password protected [28, 41]. Different approaches were taken for security of data received on smartphones such as password protection of the phone and the application [16, 22, 23, 29], and deleting all messages after one week [28]. This was considered ineffective as it was thought that messages were still available on a WhatsApp server [27]. Others felt that there was no need to delete chats as they were a form of electronic medical record, "...lost xRays are a thing of the past." [13]

In an evaluation of WhatsApp in an orthopaedic service in Spain, the messages were downloaded from phones after 8 months for evaluation [38]. Confining the messages to group members was considered a way of maintaining confidentiality [19, 29, 42].

Little was mentioned of record keeping. It must be assumed that in most groups the doctor sending the messages and acting on the responses was entering the information into the patient's file. Johnston [28] recommended downloading and storing a hardcopy of messages when deleting them from the phone after one week. Others noted that they were unable to print a record of the chat and the chat did not form part of the medical record [19, 34].

IT governance was identified as a means of addressing issues of confidentiality, privacy and data security in four papers [7, 25, 26, 28,], three related to the use of group messages in a surgery service in England [25, 26, 28] and the other to the use of social media in radiology from the Netherlands [7]. Examples of IT governance included requiring devices used to store patient safety data be approved by the information governance services [25], restricting storage of data on mobile devices to one week, de-identifying patient data and keeping adequate clinical records [28], forbidding the use of mobile devices for exchange of clinical information [26], and forbidding visitors and personnel from taking photographs on mobile devices that have immediate access to social media [7].

Patient and or family communication with health professionals was reported for palliative homecare [15], orthopaedic pin tract care undertaken by the patient [17], communication with allergists [37] and oral medicine [33].

Concordance studies looked at the quality of xRays and CT images transmitted by smartphones and images taken with smartphone cameras and transmitted by WhatsApp. There was strong agreement in the assessment of xRays and CT scans sent for assessment of tibial fractures, (kappa 0.75 – 1.0) [41], the quality of images used for management decisions after cystoscopy or ureteroscopy (85% concordance) [42],

diabetic retinopathy screening (82% specificity and 98% sensitivity) [21], and oral medicine (82% concordance) [33].

Several papers reported surveys of the way in which WhatsApp was used and the users' perceptions of its worth. A small study found that orthopaedic residents had better recall of patients' diagnosis and management after introduction of a WhatsApp group [16] and also a significant improvement in the perception of communication within the group [18]. Junior doctors were more likely to pose clinical questions and pass information while consultants/attendees were more likely to give instructions [28, 29]. Types of communication included administrative questions, clinical questions, giving information or instruction, handover, education, theatre scheduling and ordering surgical implant [28, 29, 38].

3. Discussion

WhatsApp is being used across a range of clinical services, mainly to facilitate communication within intradisciplinary groups, and mostly in the developing world. There are few one-to-one telemedicine consultation services and those that exist are triage services or in one case a screening service. Doctors appear to have been able to incorporate WhatsApp into their everyday practice without the need for additional training, either technical or vocational. In general the practical advantages of using WhatsApp outweigh the disadvantages. There is poor understanding and misconception of how WhatsApp encrypts, transmits and stores text messages and associated files. Consent, confidentiality, patient privacy, data security and record keeping have been poorly reported.

It should be noted that all the papers reviewed were written prior to the introduction by WhatsApp of end-to-end encryption of all message formats across all operating systems. Prior to April 2016 it would appear that only one-to-one text message chats using the Android operating system were end-to-end encrypted but not group chats, image, audio, video and other files. Messages sent using other operating systems were not end-to-end encrypted. Before adequate encryption was introduced there were reports of ways to "hack" WhatsApp accounts [45]. It would appear that most clinicians were not aware of the potential security and confidentiality breaches that could occur. Some erroneously believed that using a wireless connection to the Internet (preferably password protected) rather than the phone's GSM service, or that confining messages to the chat group overcame security issues, [20, 42]. Ideally there should be no patient data stored on a phone. Some have advocated deleting messages after a given period [7, 28] while others have noted the benefits of having patient data permanently stored [13]. WhatsApp data stored on phones remain encrypted but can be 'read' if the phone is unlocked. Reasonable precautions are to password protect the phone, preferably using biometrics, and password protect the application.

Local information technology governance would help clinicians better understand the issues, especially with the growing number of health professionals bringing their own devices into healthcare services. Few services were reported from the developed world with none from major OECD countries suggesting greater clinician awareness of the legal, regulatory and ethical issues around data security, confidentiality and privacy. Even with end-to-end encryption there are still security concerns. The server to which the message is initially sent may be in another country and thus jurisdiction, and illegal in those countries requiring health data be stored in-country.

Without a unique patient identifier, maintaining confidentiality is a problem. De-identifying the patient information makes knowing who is being discussed in a chat group difficult, with potentially dangerous sequelae. Providing minimal identifiers, using patient initials, or using the patient's ward, bed number, procedure and consultant allows possible identification. Patients can also be identified from photographs and no paper reported blocking out identifying features. This cannot be done within WhatsApp but there are other apps available that enable areas of photographs to be blurred or blocked.

There were few reports of consent being gained to photograph and then send patient information on WhatsApp to a group of doctors. This may be indicative of a more laissez-faire approach to consent, seen in some developing countries with few or no relevant regulations. Ideally a patient should be aware of and consent to their information being sent to a doctor or group of doctors, over the Internet, using a social media application, and then possibly being stored on the doctors' phones. They should also be told what steps are to be taken to maintain confidentiality and security of their data [7].

Record keeping and integrating WhatsApp messages with an electronic medical record was identified as a problem. Electronic and hardcopy records can be made by emailing chats from WhatsApp, including images and other attached files, ideally to a secure server. A problem then remains with identifying a patient from a chat. Whether the emails sent by WhatsApp are encrypted is not known.

The concordance studies in effect, looked at the ability to determine the clinical features in a transmitted image. This then is an issue of screen size and resolution, image resolution and photographic knowledge and skills. There have been many such studies and modern smartphones provide images of good quality. An advantage of WhatsApp is that all the image data are transmitted and the small image seen on the screen can be enlarged to view areas of specific interest.

WhatsApp is seen to improve communication within groups although some felt that it was too intrusive and that the degree of urgency was sometimes overplayed [16, 23]. Junior doctors sought advice more readily and received advice from more of their seniors [29]. This was considered to flatten the vertical hierarchy of decision making and provide a wider range of opinions and better supervision [23, 28, 29, 36], but may however reduce the autonomy of registrars/residents who would normally be called before the problem was escalated to a consultant/attending [28]. No outcome studies were reported although improvement in surgical outcomes was noted [30].

As in the South African experience, a neurosurgical service began using WhatsApp when a junior doctor was unable to send CT scan and xRays by email [30].

Conclusion

The ubiquity of WhatsApp, its simplicity, low cost and improved encryption make it an attractive proposition for developing telemedicine services in resource constrained settings. There are however few reports of consultation over distance as opposed to intradisciplinary group in hospitals. The advent of end to end encryption reduces security concerns but may face regulation in some countries. What is required now is development of guidelines for the use of WhatsApp for intradisciplinary groups and one to one telemedicine consultation. These can begin as generic guidelines that can be adapted to meet local legal, regulatory and ethical needs.

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