COVID-19 and applications of smartphone technology in the current pandemic

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ABSTRACT

Background: With restrictions on face to face clinical consultations in the COVID-19 pandemic and the challenges faced by health care systems in delivering patient care, alternative information technologies like telemedicine and smartphone are playing a key role.
Aims: We assess the role and applications of smartphone technology as an extension of telemedicine in provide continuity of care to our patients and surveillance during the current COVID-19 pandemic.
Methods: We have done a comprehensive review of the literature using suitable keywords on the search engines of PubMed, SCOPUS, Google Scholar and Research Gate in the first week of May 2020.
Results: Through the published literature on this topic, we discuss role, common applications and its support in extended role of telemedicine technology in several aspects of current COVID-19 pandemic.
Conclusion: Smartphone technology on its own and as extension of telemedicine has significant applications in the current COVID-19 pandemic. As the smartphone technology further evolves with fifth generation cellular network expansion, it is going to play a key role in future of health medicine, patient referral, consultation, ergonomics and many other extended applications of health care.

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1. Introduction

The COVID-19 disease causes a wide range of respiratory illness from the common cold to more severe disease including pneumonia and mode of transmission is predominantly by droplet spread [1–3]. To reduce the risk of person to person transmission of the coronavirus during COVID-19 pandemic, various national governments have introduced extensive 'lockdown' measures such 'social distancing' and 'shielding' of risk individuals [2]. Lockdown measures limits movement of people in communities whilst allowing essential services to continue in an attempt to curb the spread of coronavirus outbreak. Consequently the effect of COVID-19 has had a significant impact of daily life including health care and disruption of economic, social and supply chain sectors [3]. The Indian government initiated 'Lockdown' on March 25, 2020 and has extended twice until 17th May 2020, with widespread consequences [4]. Currently the use of smartphone mobile is increased as people want an update information about COVID pandemic. We explore the challenges faced during the current COVID-19 pandemic and assess the extended role of Smartphone technology (SMT) in supporting Telemedicine (TM) in its various applications.

1.1. Smartphone technology (SMT)

A smartphone is a newer class of cellular telephone with an integrated computer technology and other features such as an operating system, web browsing, and the ability to run software applications. They are called 'Smart' because they can provide information when you need them at the touch of your fingers and this can be used in a useful way. Currently smartphones are equipped with features such as camera, video recording, Global Positioning Service (GPS) navigation, and games, sending and receiving Electronic mail (email), web search applications for various purposes.

SMT has influenced areas such as business, health, social life, education, and banking and further more.

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Mobile health 'mHealth' refers to the use of cell phone technology to deliver health care. The advent of SMT has increased the potential impact of mHealth intensely and has positive implications for patients' health and the patient-clinician relationship [5].

1.2. How is it different from telephone, video technology-comparison of smartphone technology (SMT) vs tele/video?

TM tools already exist in the market with telephone and video consultations having an increasing role in health care medicine [6–8]. Information and communication technologies help in diagnosis, prevention and advice for management of acute musculoskeletal injuries and chronic orthopaedic conditions [9]. TM has found increased role in the current COVID-19 in monitoring diabetic conditions and health of patients 'self-isolating' at home [10,11].

Smart phone technology is an extended application of TM with the advantage of portability, with features such as camera, video recording, GPS navigation, sending and receiving email, web search at tips of fingers [12].

1.3. Communication modes with SMT

Video platforms: e.g. Zoom, Skype, Facetime (iPhone).
Audio platforms: e.g. telephone calls, advice etc.
Text platforms: e.g. Messaging, chat mode.

1.4. Fifth generation (5G) smartphone technology revolution

5G smartphone devices is a step forward in improving both patient care and physician competence, as well as decreasing resource consumption, which possibly may reduce healthcare costs.

5G has extremely high speed, mobility, energy efficiency and low latency, density than 4G [13]. The data provided 5G for a virtual clinic will be as good as, or better, than the face-to-face clinic this will make virtual" clinics, Interdisciplary consultation, remote monitoring of patients a reality.

With high speed data transfer capabilities, huge medical data files of imagery eg MRI and PET scan could be transported speedily and reliably. Remotely controlled surgery (Telesurgery) will be a step closer to using high speed technology due to much improved image quality and real time video communication [14].

The 5G SMT phone have ultrahigh definition and 3D video facility which helps surgeons for operative management. It can create a humanized medical environment with artificial intelligence for patients in the ICU. Though it is useful but one should also remember its adverse systemic effects related to its use as well [15].

5G SMT phone with Artificial intelligence features can contribute to the fight against COVID-19 by i) early warnings and alerts, ii) tracking and prediction, iii) data dashboards, iv) diagnosis of COVID-19 patients determine best treatment plan and predict post-operative complications to enable early interventions when necessary,v) prognosis, treatments, and cures, and vi) social control [16].

1.5. 5G SMT phone with artificial intelligence features may also play a vital role in the vaccine development for COVID-19. Practical applications of SMT during COVID-19 (Fig. 1)

1.5.1. Diagnosis and radiology

The proliferation of smartphones has driven tele-health's emergence as a tool to diagnose conditions. WhatsApp has been used as an adjunctive tool in *mHealth* in medical imaging. Naqvi GA et al. [17] performed a cross sectional study of evaluating accuracy of diagnosis of fracture radiographs sent on mobile phones through multimedia messaging (MMS) compared to radiology report. They found accuracy of 97.7% with 100% sensitivity and 94.4% specificity. Furthermore KApicioglu M et al. [18] evaluated the reliability of WhatsApp application in assessing the X ray images of children between 2 and 10 years of age with supracondylar fracture of humerus compared with the Picture Archiving and Communication system (PACS). They found that WhatsApp is an effective and accurate in managing these injuries in emergency setup.

1.5.2. Healthcare and medicine

It has been difficult for many patients to reach hospitals in lockdown period. To help these patients, many hospitals have started telemedicine outpatient services. SMT allows remote consultation, advice and reassurance. SMT thus helps in assessment, triage, diagnosis and planning further management [8,11].

1.5.3. Trauma and orthopaedics surgery applications

Virtual Fracture Clinics (VFC) are newer ways of assessing and managing musculoskeletal injuries [9]. SMT can be used to undertake VFC and also monitor chronic orthopaedic conditions such as osteoarthritis in COVID-19 pandemic period when patients are unable to travel due to Lockdown restrictions and injury [7,11].

1.5.4. Tertiary referral

Studies have shown that smartphone use has helped in avoiding unnecessary visits to the tertiary hospital and also decreased the incidence of missed diagnosis of fractures in patients in general practice [19].

1.5.5. Counselling

With the effects of 'self-isolation' and 'shielding' on Mental health, low mood and depression has been acknowledged as an issue during the COVID-19 pandemic. SMT can help in mental health advice and counselling to reassure patients and thus provide support [20].

1.5.6. Education and training

COVID-19 has had a significant effect in on education and training. As almost all scheduled conferences, seminars, workshops and other academic activities have been cancelled the number of online seminars called 'webinars' has increased tremendously and easily accessible with SMT. Educational institutes have been closed down and teachers have been taking lectures online. Students are accessing these lectures online through the help of smartphones [21].

1.6. SMT extended applications during COVID-19 pandemic

1.6.1. Group counselling

A group of people can be counselled about health advice, exercise programme using ZOOM, Skype or Facetime technological applications to maintain guidelines of social distancing but providing continuity of care [22].

1.6.2. Covid-19 monitoring

To combat COVID-19, it's important to know the accurate location of the people infected with it. Accurate locations can be detected using GPS and also proximity between infected users can be detected via Bluetooth feature on smartphones. Mobile phone data can provide access to population estimates and other mobility information, which can further be used by different sectors to understand COVID-19 trends and act proactively [23].
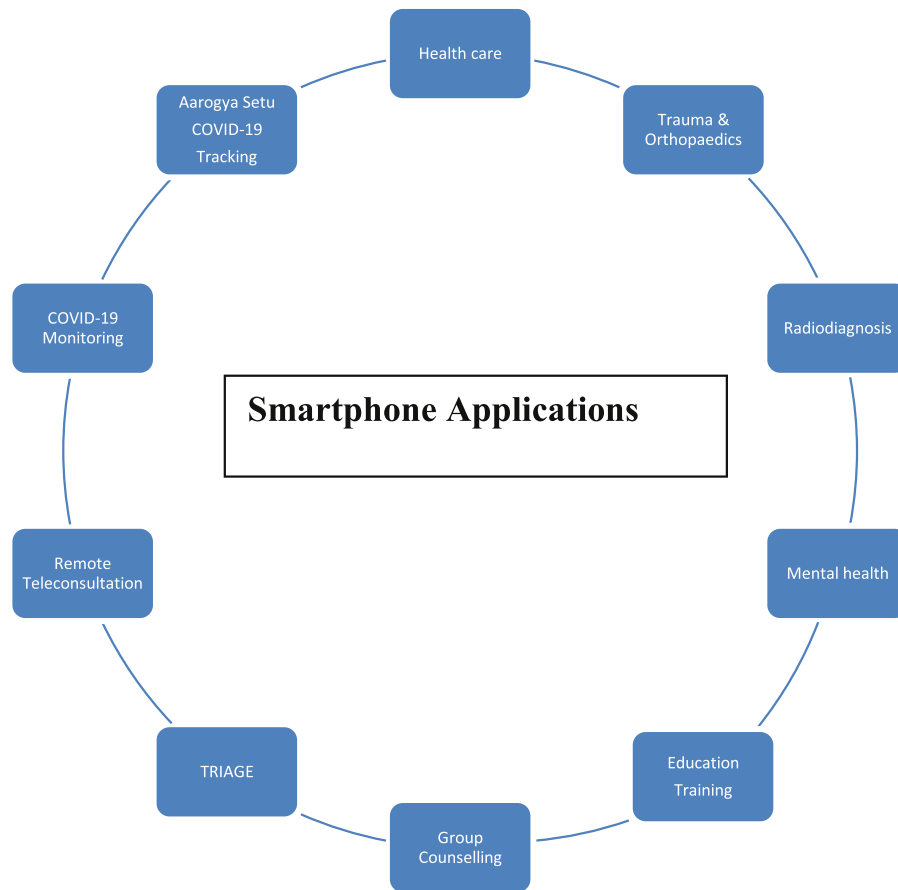
Fig. 1. Smartphone technology applications and COVID-19 pandemic.

1.7. COVID-19 India and smartphone technology

SMT has offer enormous opportunity for Indian health care professional and caregivers during COVID- 19.

Aarogya Setu (lit. 'Health Bridge') is a COVID-19 tracking mobile application developed by the National Informatics Centre that comes under the Ministry of Electronics and Information Technology, Government of India [24]. This is a tracking app which uses smartphone's GPS and Bluetooth features to track the coronavirus infection. Aarogya Setu app is available for Android and iOS mobile operating systems. Using Bluetooth technology, the Aarogya Setu app tries to determine the risk if one has been near a Covid-19 infected person (within six feet of distance) by scanning through a database of known cases across India, and using location information it determines the location one is in belongs to the infected areas based on the data available.

1.8. Side effects of SMT

An overuse and misuse of SMT may pose users to some side effects, similar to repetitive stress injuries in computer professionals. Undue and prolonged stress due to overuse of SMT may cause pain in the neck, elbow, wrist and hand (Table 1) [25,26].

Putting neck and upper limb in an uncomfortable positions for a prolonged period of time, can lead to strains and overuse injuries, this causes pain in neck, upper back, shoulder, and upper limbs as well as numbness and tingling in hands and fingers.

1.9. Text neck is the term used to describe the neck pain due to inappropriate neck posture or sustained flexion of cervical spine for looking down at SP [27]

Cell phone elbow/prolonged-phone-posture (PPP) occur due to bending or flexed posture the elbow for long periods of time while using the phone for audio call. These positions can progressively irritate the ulnar nerve [28].

Texting tenosynovitis it is triggered by a Stenosing inflammation of the tendon sheath of abductor pollicis longus and extensor pollicis brevis in the first dorsal compartment of the wrist. Texting, messaging and gaming require repetitive redundant movements of the thumb which irritates the tendon. Pain over the surface of the radial aspect of the wrist and weakness and dysesthesias, such as numbness, tingling, burning, and cramping over the base of the thumb/wrist due to frequent text messaging [29].

Commonly associated conditions with repeated and overuse of smart phones include: Table 1.

1.10. Good practice guidance recommendations for appropriate use of smart phone

It is important to observe some good practices while using smartphones to avoid medical problems (Table 2).

1.11. Limitations of SMT

It is important to know that many mobile applications and devices currently lack the certain parameters which are required to

Table 1
Commonly associated conditions with repeated overuse of smart phones.

Site	Pathology/Mechanism	Condition
Cervical spine	Posture/Positional/Mechanical	Neck pain (Text Neck)
Shoulder	Posture/Postural	Shoulder pain
Neck		Thoracic Outlet syndrome
Neck, Shoulder, Thoracic Spine		Fibromyalgia
Elbow		Cubital Tunnel syndrome (Cell phone elbow)
Wrist	Overuse	Dequervain's Tenosynovitis (Texting tenosynovitis, or Blackberry Thumb or WhatsAppitis)
Wrist	Overuse	Extensor tendinitis
Wrist and Hand	Overuse	Carpal Tunnel syndrome
Thumb	Overuse	Extensor Pollicis Longus tendinitis/rupture (Swiper's thumb and iPad hand)
Hand, Thumb	Overuse	Myofascial syndrome of Adductor pollicis, first interosseous, Extensor Digitorum Communis muscle
Hand, Thumb	Overuse	Weakness of grip, pinch
Lumbar spine	Posture/Positional/Mechanical	Low back ache

Table 2
Good practice guidance recommendations for appropriate use of Smart phone.

Good Practice	Avoid
Do support the forearms	Avoid sitting with the head bent forward
Do use both thumbs	Avoid texting with high speed
Do use smartphone while sitting (and not walking)	Avoid Elbow flexion
Do keep switching hands while using mobile phone	Don't use smartphone whilst driving
Do keep your wrists straight While using smartphones	Avoid marathon browsing or messaging session
Do try to hold your phone in both the hands	Avoid use smart phone for more than 15–20 min at a time

make them reliable and viable tools. Like any other digital health innovation, Mobile health technology is no exception. It also faces privacy and data ownership issues [30]. The challenges it poses could in itself be motivation for further developments and innovations.

2. Conclusion

Smartphones have been extensively used worldwide for the last couple of decades, but have recently found numerous medical applications during COVID-19 pandemic. These phones help in avoiding the face-to-face contact of the healthcare provider with the patients and thus maintain social distancing and avoid virus transmission. These phones are valuable in making the clinical evaluation, diagnosis, timely advice, prescription and also in the monitoring of the patients from their home and in remote areas. If the smartphones are used correctly and with due care, repetitive stress injuries to the musculoskeletal system can be avoided.

Author's contributions

VKJ concept of manuscript, KP involved in manuscript design KP; VKJ, GKU involved in literature search, writing, editing, drafting, RV writing, editing, drafting of manuscript.

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Patient consent for publication

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Declaration of competing interest

The authors declare No conflict of interest.

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