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REVIEW ARTICLE

# Virtual Fracture Clinic Model in India: A Technological Innovation

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## Abstract

**Background** Virtual Fracture Clinics (VFCs) are an alternative to the conventional model of fracture and minor injuries care. It is a new, evolving service designed to speed up patient access to orthopaedic care introduced in the United Kingdom in 2011 and has been increasingly used in the management of certain musculoskeletal injuries.

**Methods** This observational, pilot study evaluates the possibility of combining telemedicine technology and a virtual fracture clinical assessment pathway to remotely assess patients supported by radiology imaging in India.

**Results** Piloting and developing a virtual fracture clinical assessment pathway model in India is faced with many challenges including regulations, internet, and data connectivity issues, and concerns of medico-legal implications.

**Conclusion** Recent studies have reported Virtual Fracture Clinics (VFCs) to be able to provide a safe, cost-effective model of patient care in a subset of musculoskeletal injuries. Limitations and shortcomings of Virtual Fracture Clinics (VFCs) in India can be mitigated with effective communication, enhanced documentation, appropriate training, and information governance. This pathway is not a replacement for conventional 'face-to-face' evaluation but a credible option to complement the delivery of trauma and orthopaedic care in the future in India.

**Keywords** Orthopaedics · Telemedicine · Virtual fracture clinic

## Introduction

Virtual Fracture Clinics (VFCs) are an alternative, innovative way of managing certain musculoskeletal injuries compared to the traditional 'face-to-face' fracture clinics [1]. Essentially an extended application of video consultation strategies, it allows initial triage, and assessment of common injuries and fractures with the ability to advise patients remotely [2].

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## Virtual Fracture Clinic

The concept of VFC provides a quality improvement service model designed to speed up and improve patient care in the remote management of common injuries. Standardizing referral protocols from the Accident and emergency department (AED) and treatment guidelines are found to give an enhanced patient experience. As resources are stretched across the health care system due to increased injury burden and with the drive to find alternative cost-effective modes of patient care, the VFC model of managing a common orthopaedic injury is an attractive proposition. They are a safe, cost-effective, and care model in treating outpatient injuries with increasing patient satisfaction rates [3, 4]. The virtual fracture clinic is set-up for musculoskeletal injuries that do not require operative intervention and to limit avoidable follow-up appointments in traditional fracture clinics. The AED must be aware of which injuries are suitable for VFC.

The VFC is not suitable for compartment syndrome open injuries, fractures with neurovascular deficits, displaced fractures and or potentially unstable fractures, and multi-ligamentous injuries with or without dislocations. These require emergent surgery or close monitoring in the

clinic and must be referred urgently to orthopaedics on-call facilities.

The common orthopaedic injuries which can be easily managed through the model of VFC without any referral are torus buckle and greenstick paediatric fractures, undisplaced radial head/neck fractures, mallet finger or baseball finger injuries without bony involvement, elbow 'fat pad positive' injuries, elbow undisplaced fracture, paediatric undisplaced stable clavicle fracture, metacarpal with no rotational or angulations phalangeal base and neck of $5^{th}$ metatarsal fractures, lesser toe fractures, undisplaced Acromio-clavicular joint injuries, ankle sprains, stable Weber B ankle fractures, etc. [5, 6]. These patients can be managed with plaster of Paris back-slab, splints, slings, walking boots, buddy strapping splints, cuff and collar slings, crepe bandages, and footwear advice. Sometimes no splints are required to immobilize an injury. Follow-up radiological imaging usually is not required to check for fracture union in most of these injuries. The outcome of the initial fracture assessment could be injury specific -with options of the need for operative intervention / attendance for face-to-face clinic or Virtual follow-up appointments.

## Need for VFC in India

In India, the orthopaedic outpatient and emergency departments in public and private hospitals are often flooded with patients [7]. Most patients attending the hospital are for minor injuries which can be managed conservatively. There is a paucity of orthopaedic surgeons across India with a poor orthopaedic surgeon and a patient ratio of about one surgeon for every 62,500 people [8]. Most of these surgeons practice in urban areas. Therefore, rural and remote areas in India lack orthopaedic surgeons; however, every village is provided with a primary health care centre with a doctor of MBBS level. A lot of patients with minor injuries seeking care in tertiary centres can be avoided if the VFC model is applied with the help of teleconsultation at this level to seek consultation from a consultant-level doctor. This provides patients a timely opinion on their injury by avoiding delay in diagnosis and treatment avoiding unnecessary follow-up imaging. The current overcrowding situation in trauma centres and traditional outpatient clinics can be avoided. VFC further reduces the infection risk to the staff and health care providers due to the remote nature of the clinic. In addition, the need for transportation of a patient can be avoided which itself can be cost-prohibitive and not universally available. The overall VFC is expected to be cost-effective for the hospital and consultant doctors can make better use of time in the management of other clinical priorities.

## Advantages of VFC

A variety of common paediatric and adult musculoskeletal injuries can be managed with VFCs [4, 9, 10]. It can be able to support the traditional 'face-to-face' model of fracture care by reducing waiting times for review and freeing up appointments for patients who need to be assessed in formal fracture clinics [4]. VFCs are a cost-effective way to manage a subset of injuries with gross value-added savings combined with the economic benefits of travel-related time funds and a reduction in the number of follow-up appointments [4, 11]. VFCs have also been demonstrated to be compliant with guidelines recommended by The National Institute for Health and Care Excellence (NICE) and the British Orthopaedic Association (BOA) for fracture care [3, 12]. VFC pathways have been proven to reduce unnecessary reattendance of patients at face-to-face fracture clinics for a review of stable, self-limiting injuries with significant benefits to the AED [13]. Studies show that patient satisfaction with VFC is high and patients can be seen within 72 h of AED presentation through VFC [14, 15].

## Telemedicine in India

Telecommunication technology has improved in leaps and bounds in India with low-tariff providers and support from the Government of India to develop telemedicine. The Ministry of Health and Family Welfare, the Government of India, and the Medical Council of India (MCI) have recently come forth with Telemedicine Practice Guidelines that clearly state the role and limitations of teleconsultations [16]. The Government of India has recently launched the e-Sanjeevani OPD, a national teleconsultation service, as mandatory for healthcare providers. Through e-Sanjeevani OPD, patients can medical advice through audio and video. With this service, people living in the remotest areas will also be able to get their health-related consultation [17]. Telemedicine has an evolving role in various specialties in India including diabetes care, oncology, and managing orthopaedics [18–20]. However, the implementation of telemedicine technology in India has not been without its inherent problems with data connectivity and end-user availability [21]. Steps can be undertaken to avail telemedicine facilities for effective and safe patient care. Development of VFC in the model in India will not be without challenges but be mitigated with effective communication, enhanced documentation, appropriate training, and information governance.

## Establishment and Organization of the VFC Assessment Pathway

VFC model of care requires an infrastructural set-up including appropriate virtual clinic rooms with video monitors, fast broadband internet connection, link-up Picture Archiving, and Communication System for radiology (PACS), and an Electronic patient record system (EPR) which can be accessed remotely as shown in Fig. 1. It is a multi-disciplinary team effort led by an orthopaedic clinician and supported by an orthopaedic trauma nurse, and physiotherapist to provide therapy advice along with administrative assistance to record outcomes, and arrange forward appointments. The VFC booking system is populated by established clinical referral pathways as shown in Fig. 2.

A VFC is set-up for minor injuries that require conservative treatment only. The emergency department must be aware of which injuries and patients are suitable for consultation in VFC. A referral protocol is set-up for VFC and agreed upon between AED and orthopaedics to streamline appropriate patients.




**Fig. 1** Virtual fracture clinic consultation set-up planning guide

## VFC Referrals

New patient appointments in the VFC are organized with referrals from Accident and emergency department (AED), General practitioners (GP) (primary care physicians), or from the various regional minor injuries (walk-in) clinics. Any patient with a minor musculoskeletal injury can be referred to the VFC depending on agreed protocols. The patient's details including a brief history and phone number are recorded electronically and emailed to the orthopaedic trauma nurse running VFC. The following day the orthopaedic trauma nurse and orthopaedic Consultant run the VFC for all injuries referred in the past 24 h. In the VFC, the Consultant reviews the radiographs and decides on a management plan for all patients e.g. analgesia and discharge. If there are any concerns, the patient can be booked into a clinic for review. Triage and initial remote assessment by a senior clinician allow a confident decision-making process. Following the initial remote consultation, a management plan can be organized for the patient. Patients who have stable injuries may be discharged with a self-management and treatment plan. These patients are provided with a 'patient information leaflet' and a helpline telephone advice number. The Consultant dictates the decision so there is a record for medico-legal purposes. A detailed VFC consultation letter is sent to the GP with a copy of the clear management plan as discussed during the virtual appointment.

If on assessment of the clinical condition or the injury during the VFC assessment, it is felt that a formal clinical evaluation is necessary, then there is a mechanism for the patient to be booked into the next available sub-specialty clinic [3]. There is also an option of pre-arranging appropriate radiographs such as special views for individual fractures or complementary imaging using Magnetic Resonance Imaging (MRI) or Computerised Tomography (CT)scans. Thus, VFCs are specialized fracture clinics that offer 'one stop' assessment, management advice, or further referral as shown in Fig. 3.

There is a further option to organize formal physical therapy e.g. hand therapy for functional recovery in either dedicated 'face-to-face' therapy clinics or virtual telehealth clinics which allow remote monitoring with advice for supervised exercise programmes.

The concept of a 'Safety net' is a key principle of VFC. A dedicated hotline or helpline is established to allow any patients who have been discharged following the VFC appointment to be able as a focal contact point for any future advice they may require or if their clinical condition changes to cause them concern.

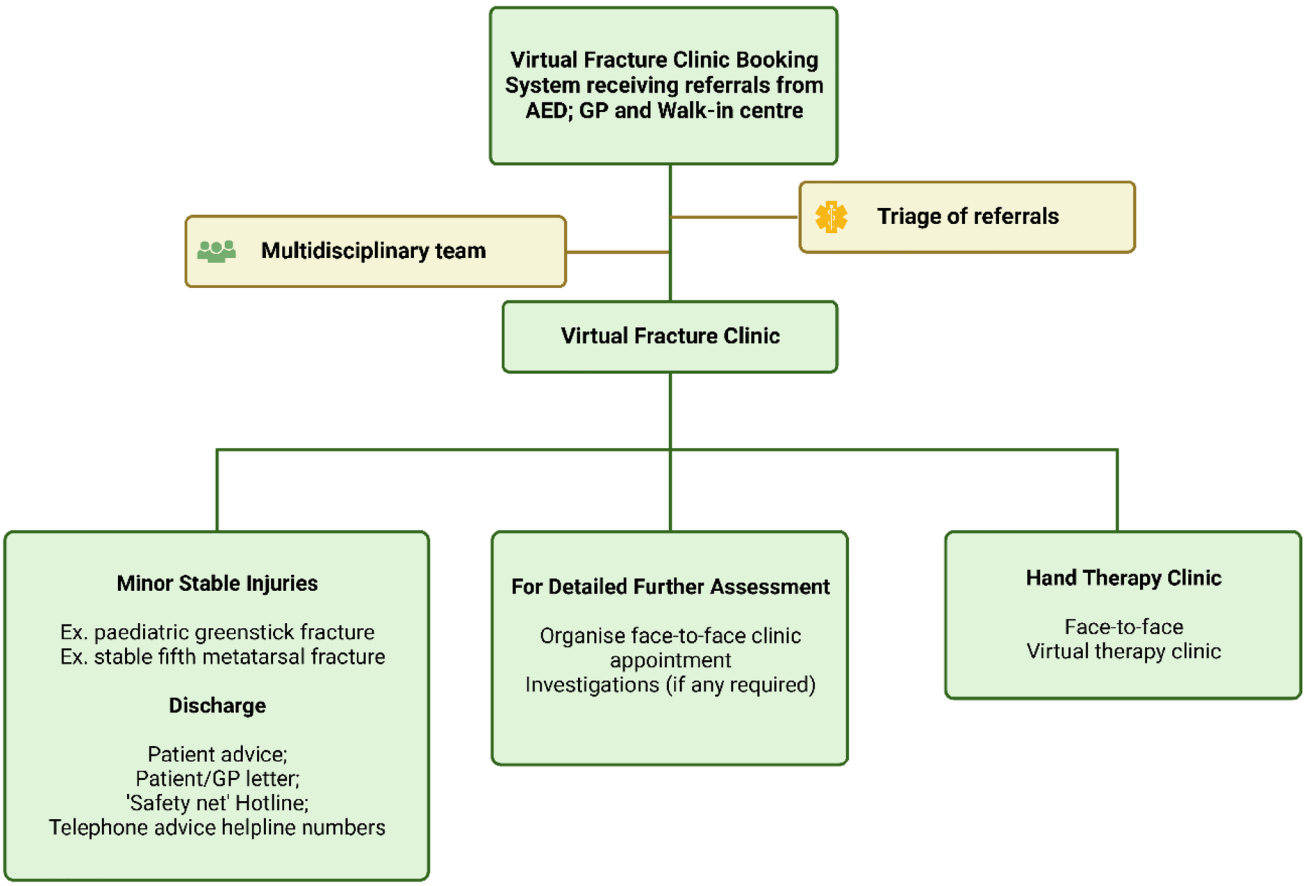



**Fig. 2** Virtual fracture clinic patient pathway flow-diagram

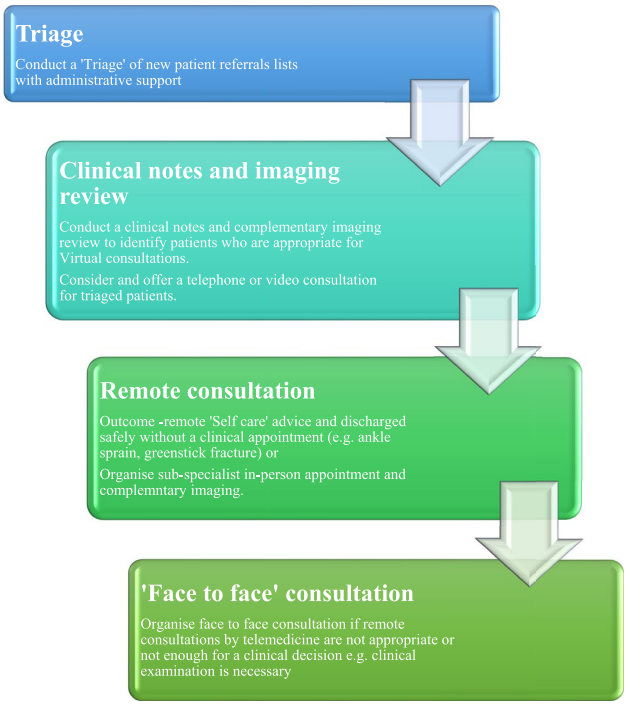



**Fig. 3** Virtual fracture clinic decision-making pathway

## Pitfalls Envisaged and Strategies in Setting up VFC in India

1. *Technological Set-Up and Digital Connectivity* The VFC model will require infrastructure organization with the setting up of 'Virtual consultation rooms'. Figure 1 highlights the step guide involved in the setting of a VFC. Appropriate Telemedicine (TM) applications including compatible computer or mobile devices with fast fibre broadband internet connectivity are essential for reliable image transfer. Traditionally this can be a hindrance in the promotion of VFC. However, India is improving in digital connectivity with the development of 5G networks, the availability of handheld smartphones, and various web-based platforms for virtual medical consultation [22]. Recently it is the plan of the government of India under the Digital India Bharat Mission to connect over 6 lakh villages through a high-speed optical fibre. It will help in providing high-speed internet to villages thereby aiding the doctors to provide telehealth services [23]. The-Sanjeevani OPD, a national teleconsultation service, is expected to be enhanced, providing virtual consultation facilities to remote and rural villages.

2. *Training* VFC is a multi-disciplinary collaboration. Training and learning skills in dealing with remote consultations are essential to provide safe and effective patient care. Training will develop confidence in clinicians and the ancillary staff in organizing appropriate patient pathways for VFC, and analyse which patients can be assessed by VFC and which need traditional outpatient or emergency care. This will minimize clinical and medico-legal mistakes.
3. *MCI Updated Guidelines* The Medical Council of India (MCI) and General Medical Council (GMC) have published telemedicine practice guidelines enabling registered medical practitioner/s (RMP) to provide health care [16, 24]. Adopting good practice guidelines will support health care professionals in avoiding common pitfalls associated with telemedicine consultations [25].
4. *Medico-Legal Implications* This is a concern that forms a current hesitation in developing VFC in India. A common worry is missed injuries and who will be responsible for this event. The VFC mode of care is a safe and effective model of care for common musculoskeletal injuries in multiple studies [5, 11]. Common pitfalls can be mitigated by understanding the limitations of virtual consultations. Verbal virtual consent, explanation of limitations of virtual assessment to the patient, and enhanced documentation will provide reassurance to the patient. Communication is the key. As suggested in the development of the pathway, there should be a provision for 'Safety Netting'. This allows the patient to approach appropriate channels for management of any concerns or avail 'face-to-face' assessment. This will also reassure clinicians. Enhanced clinical protocols will allow clinical assessment, discussion management, and follow-up care plans. Information leaflets and web-based orthopaedic association portals can be explained to patients during their self-care.

## Limitations of the VFC Model in India

- The authors acknowledge that the proposed VFC pathway is not a current route of assessment yet in developing countries like India, however, VFC has been validated as a model of care for the stable and non-emergency types of fractures which traditionally are assessed in an outpatient clinic set-up.
- Non-availability of digitalized health data of the dynamic population in India with the practicing health professionals.
- There are considerations for technical set-up and digital connectivity for setting up the VFC model in India with its financial and resource constraints. However, India has shown progress in digital connectivity with the introduction of 5G and smartphone technology. Tariffs can be supported by government and national initiatives for supporting health transformation in India.
- The lack of technical knowledge among the rural and semi-urban population limit the usage of VFC in India.
- Medico-legal implications and concerns are genuine. Development of standard operating protocols, staff training, patient information, regular audits, and review of practice including enhanced documentation and effective communication with patients will reassure both doctors and patients. Urgent and emergency injuries would still require traditional standards of care with assessment in accident and emergency departments for appropriate management. VFC is not expected to replace this element of patient care.

## Conclusion

VFC model is a safe, cost-effective patient-centred efficient model of care for common paediatric and adult musculoskeletal injuries. The VFC model can be altered to suit the demographics of the population and even the hospital set-up. So, to begin with, this model can be stated in some hospitals with enhanced telemedicine technology, infrastructure, and ancillary support. This can be reviewed later with the audit of patients and staff evaluation of practice and further modifications made. Limitations and shortcomings of VFC can be mitigated with effective communication, enhanced documentation, and information governance. VFC will be is a key mechanism in the delivery of trauma and orthopaedic care in the future and a credible option to complement the traditional 'face-to-face' fracture clinic.

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### Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical standard** This article does not contain any studies with human or animal subjects performed by the any of the authors.

**Informed consent** For this type of study informed consent is not required.

## References

1. Iyengar, K., Vaish, A., Toh, E., & Vaishya, R. (2020). COVID-19 and remote consulting strategies in managing trauma and orthopaedics. *Postgraduate Medical Journal, 96*(1137), 438–439. https://doi.org/10.1136/postgradmedj-2020-137917

2. Greenhalgh, T., Vijayaraghavan, S., Wherton, J., Shaw, S., Byrne, E., Campbell-Richards, D., Bhattacharya, S., Hanson, P., Ramoutar, S., Gutteridge, C., Hodkinson, I., Collard, A., & Morris, J. (2016). Virtual online consultations: Advantages and limitations (VOCAL) study. *British Medical Journal Open, 6*(1), e009388. https://doi.org/10.1136/bmjopen-2015-009388
3. Logishetty, K. (2017). Adopting and sustaining a Virtual Fracture Clinic model in the District Hospital setting—A quality improvement approach. *British Medical Journal Quality Improvement Reports, 6*(1), u220211.w7861. https://doi.org/10.1136/bmjquality.u220211.w7861
4. Murphy, E. P., Fenelon, C., Murphy, R. P., O'Sullivan, M. D., Pomeroy, E., Sheehan, E., & Moore, D. P. (2020). Are virtual fracture clinics during the COVID-19 pandemic a potential alternative for delivering fracture care? A systematic review. *Clinical Orthopaedics and Related Research, 478*(11), 2610–2621. https://doi.org/10.1097/CORR.0000000000001388
5. Bellringer, S. F., Brogan, K., Cassidy, L., & Gibbs, J. (2017). Standardised virtual fracture clinic management of radiographically stable Weber B ankle fractures is safe, cost effective and reproducible. *Injury, 48*(7), 1670–1673. https://doi.org/10.1016/j.injury.2017.04.053
6. Robinson, P. M., Sim, F., Latimer, M., & Mitchell, P. D. (2017). Paediatric fracture clinic re-design: Incorporating a virtual fracture clinic. *Injury, 48*(10), 2101–2105. https://doi.org/10.1016/j.injury.2017.08.006
7. Jain, V. K., & Vaishya, R. (2020). COVID-19 and orthopaedic surgeons: The Indian scenario. *Tropical Doctor, 50*(2), 108–110. https://doi.org/10.1177/0049475520921616
8. Jain, A. K. (2016). Current state of orthopaedic education in India. *Indian J Orthop, C50*, 341–344. https://doi.org/10.4103/0019-5413.185586
9. Seewoonarain, S., Babu, S., Sangoi, D., Avasthi, A., & Ricketts, D. (2019). Introducing a virtual fracture clinic increases efficiency and reduces costs in torus fracture management. *Pediatr Qual Saf., 4*(6), e202. https://doi.org/10.1097/pq9.0000000000000202
10. Evans, D., Hardman, J., Middleton, S. D., & Anakwe, R. E. (2018). Developing a virtual fracture clinic for hand and wrist injuries. *J Hand Surg Eur, 43*(8), 893–894. https://doi.org/10.1177/1753193418778472
11. McKirdy, A., & Imbuldeniya, A. M. (2017). The clinical and cost effectiveness of a virtual fracture clinic service: An interrupted time series analysis and before-and-after comparison. *Bone Joint Res., 6*(5), 259–269. https://doi.org/10.1302/2046-3758.65.BJR-2017-0330.R1
12. British Orthopaedic Association. Legal aspects of virtual fracture clinics. Retrieved from https://www.boa.ac.uk/resources/medicolegalarticles/legal-aspects-of-virtual-fracture-clinics.html. 10 Oct 2020.
13. Vardy, J., Jenkins, P. J., Clark, K., Chekroud, M., Begbie, K., Anthony, I., Rymaszewski, L. A., & Ireland, A. J. (2014). Effect of a redesigned fracture management pathway and 'virtual' fracture clinic on ED performance. BMJ Open. *4*(6), e005282. https://doi.org/10.1136/bmjopen-2014-005282.
14. Thelwall, C. (2021). A service evaluation after 4 year's use of the virtual fracture clinic model by a district general hospital in the south west of England. *Int J Orthop Trauma Nurs., 41*, 100798. https://doi.org/10.1016/j.ijotn.2020.100798
15. Rhind, J. H., Ramhamadany, E., Collins, R., Govilkar, S., Dass, D., & Hay, S. (2020). An analysis of virtual fracture clinics in orthopaedic trauma in the UK during the coronavirus crisis. *EFORT Open Rev., 5*(7), 442–448. https://doi.org/10.1302/2058-5241.5.200041
16. Ministry of Health and Family Welfare, Government of India. Telemedicine practice guidelines. Retrieved from https://www.mohfw.gov.in/pdf/Telemedicine.pdf. Published 25 March 2020. 10 Oct 2020.
17. Government of India. E-Sanjeevani. Retrieved from https://esanjeevani.com/. 10 Oct 2020.
18. Ghosh, A., Gupta, R., & Misra, A. (2020). Telemedicine for diabetes care in India during COVID19 pandemic and national lockdown period: Guidelines for physicians. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14*(4), 273–276. https://doi.org/10.1016/j.dsx.2020.04.001
19. Mayadevi, M., Thankappan, K., Limbachiya, S. V., et al. (2018). Interdisciplinary telemedicine in the management of dysphagia in head and neck. *Dysphagia, 33*(4), 474–480. https://doi.org/10.1007/s00455-018-9876-9
20. Lal, H., Sharma, D. K., Patralekh, M. K., Jain, V. K., & Maini, L. (2020). Out Patient Department practices in orthopaedics amidst COVID-19: The evolving model. *J Clin Orthop Trauma., 11*(4), 700–712. https://doi.org/10.1016/j.jcot.2020.05.009
21. Ghosh, A., Dutta, K., Tyagi, K., Gupta, R., & Misra, A. (2020). Roadblock in application of telemedicine for diabetes management in India during COVID19 pandemic. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14*(4), 577–578. https://doi.org/10.1016/j.dsx.2020.05.010
22. Iyengar, K., Upadhyaya, G. K., Vaishya, R., & Jain, V. (2020). COVID-19 and applications of smartphone technology in the current pandemic. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14*(5), 733–737. https://doi.org/10.1016/j.dsx.2020.05.033
23. Ministry of Electronics and Information Technology, Government of India. Retrieved from https://digitalindia.gov.in/. Accessed 10 Oct 2020.
24. General Medical Council. Good medical practice. (Updated 29 April 2019). Retrieved from https://www.gmc-uk.org/ethical-guidance/ethical-guidance-for-doctors/good-medical-practice.
25. Iyengar, K., Jain, V. K., & Vaishya, R. (2020). Pitfalls in telemedicine consultations in the era of COVID 19 and how to avoid them. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14*(5), 797–799. https://doi.org/10.1016/j.dsx.2020.06.007


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