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Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Learning opportunities from COVID-19 and future effects on health care system

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ARTICLE INFO

Article history:

Received 2 June 2020

Received in revised form

15 June 2020

Accepted 16 June 2020

Keywords:

COVID-19

Coronavirus

Pandemics

Health care systems

Telemedicine

ABSTRACT

Background and aims: COVID-19 has had a crippling effect on the health care systems around the world with cancellation of elective medical services and disruption of daily life. We would like to highlight the learning opportunities offered by the current pandemic and their implication for a better future health care system.

Methods: We have undertaken a comprehensive review of the current literature to analyse the consequences of COVID-19 on health care system. Using suitable keywords like 'COVID-19', 'telemedicine', 'health care' and 'remote consultations' on the search engines of PubMed, SCOPUS, Google Scholar and Research Gate in the first week of May we gathered information on various aspects of effect of COVID-19. **Results:** There has been a shared drive worldwide to devise strategies to protect people against viral transmission with reinforcement of hand hygiene and infection control principles but also to provide continuity of health care. Virtual and remote technologies have been increasingly used in health care management.

Conclusion: COVID-19 has offered unique learning opportunities for the health care sector. Rationalizing and optimizing available resources with resilience shown on the coronavirus frontline during the crisis are some of most important lessons learnt during the crisis. Importance of personal hygiene and reinforcement of infection control measures have been acknowledged. Telemedicine revolution will be a vital factor in delivering health care in the future.

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1. Introduction

The novel Coronavirus SARS-CoV-2 (COVID-19) pandemic began in Wuhan (China) in December 2019 and spread worldwide [1]. It has now spread to over 200 countries and the latest World Health Organisation (WHO) reports there are over 4 million confirmed cases of COVID-19 with more than 300,000 deaths (May 17, 2020) [2].

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Predominantly a respiratory illness, the novel coronavirus respiratory spreads predominantly by droplets and is highly contagious [3]. Serious illness requires hospital admission [4]. To prevent the spread of this contagious virus, national governments have introduced 'lockdown' measures with infection control strategies including 'social distancing' and 'self-isolation' guidelines which severely restricts the movement of people and affects their daily life [5,6]. Lockdown and strategies to prevent COVID-19 viral transmission has caused significant economic, geopolitical and health consequences all over the world [7].

COVID-19 has had significant effect in normal working of health care organisations (Fig. 1). It has made patients staying away from accident and emergency departments and reaching out for urgent medical conditions such as heart, cancer illnesses.

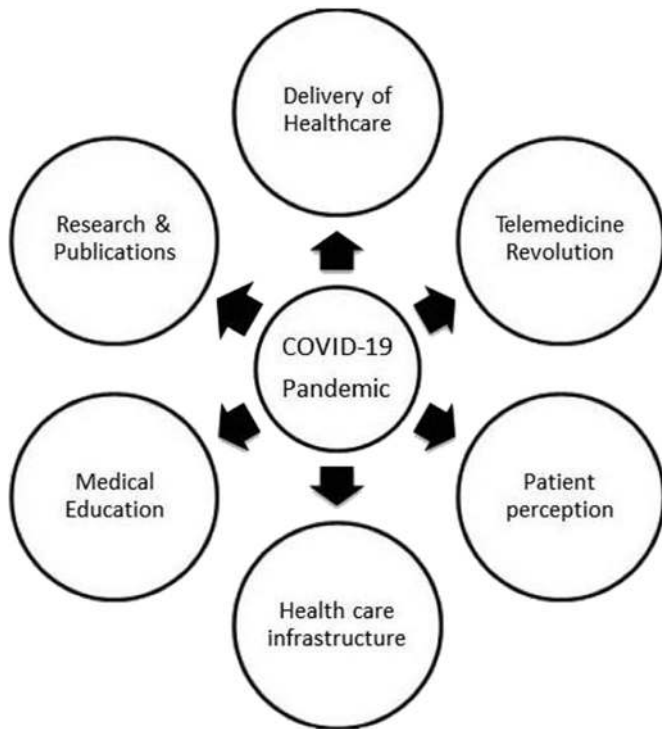


Fig. 1. Lessons learnt from COVID-19 Pandemic to improve future health care reforms.

2. Developments

2.1. Delivery of health care

2.1.1. Acute care

As the pandemic expanded, the way different medical departments function had to be re-organised to deliver a continuity of care but also take steps to prevent viral transmission and protect both patients and staff. Patient administration systems (PAS) have been updated to accommodate different clinic templates e.g. telephone clinics, video clinic rooms for remote consultations radically different from the traditional face to face consultations. This is going to be a model of care in the future and the current experience is going to be helpful in the future of acute care delivery e.g. triaging of acute hand and wrist injuries in the trauma and orthopaedic department.

2.1.2. Redeployment opportunities

Doctors and health care staff have accepted this challenge and learning new skills in a new environment. This pandemic has given the opportunity to many doctors to experience the work environment in different specialities. Team working has improved. These skills may be helpful to individuals in the future if a career change is thought of or for trainees can learn new skills to apply in the future clinical medicine. It has proven the versatility of the medical careers [8].

2.1.3. Staff resilience

Staff on the frontline even with concerns of infection, Personal Protective Equipment (PPE) shortage have been working hard on the coronavirus frontline to treat and save patients. Doctors, nurses, carers and paramedics around the world are facing an unprecedented workload in overstretched health facilities. This resilience should be a blue print for the future with appropriate protection of the staff on the frontline [9,10].

2.1.4. Out-patient services-delivery

This probably will be one of the most significant changes as we progress in the Post- COVID-19 phase. To reduce the number of 'face to face' consultations, the way out-patient services are delivered has completely changes during the pandemic. Remote consultations including telephone and Video platforms have evolved significantly to provide a continuity of care [11]. E.g. Trauma and orthopaedic departments have set-up rapid access 'One stop' clinics set up where patients have everything completed in a single environment for their injuries. Minor injuries and day case procedures are organised in a way where further follow-up face to face appointments are kept to a minimum with patient centred self-care [12]. In chronic diseases such as diabetes and hypertension it allows remote monitoring and provides a continuity of care for the patients [13–15].

2.2. Health care infrastructure

2.2.1. Health care service capacity-

During this pandemic there was a surge capacity in mass critical care which means an expansion of intensive care units' ability to care to as many patients as possible. The four necessary components of surge capacity are staff, supplies, space, and structure. E.g. Multiple hospital units over the last few months during the pandemic to increase capacity of intensive care beds and ventilators (e.g. NHS Nightingale hospitals). This increased capacity will help deliver the post-COVID-19 strategy to resume elective surgery [16].

2.2.2. Equipment

NHS has built a backlog and storage/stockpile of Ventilators. It will be useful for the current NHS and future pandemic. A team of engineers from UCL (the university in London and Formula One engine maker Mercedes-AMG HPP have been working flat out to manufacture large numbers of a continuous positive airway pressure (CPAP) devices. Within one month, 10,000 devices have been delivered to meet the UK government target [17]. This has shown the versatility and the spirit of support and unity of all community sectors to help out during a disaster.

2.2.3. Government initiatives

COVID 19 has exposed health care system of many countries including India. In India public health-care system is grossly underfunded and patchy while private health-care sector is unregulated. The Indian government's expenditure on health as a percentage of GDP is around 1.5%. There are several gaps in India's preparedness for COVID-19 pandemic [18]. This pandemic could be the much-needed wake-up call to the necessity of long-term changes to India's health [19]. Recently taking in account during pandemic the Indian government has increased expenditure in the public health system to reboot healthcare. The government has launched an ambitious project 'aatmanirbharbharat' to become more self-reliant with investment in acquiring and building lifesaving equipment's like PPE, ventilators, building hospital infrastructure, ICU beds, oxygen supply in hospitals, strengthening of laboratories, hiring of additional human resources which were scarce before pandemic [20,21]. All this will improve the health care system and facilities in India.

2.3. Telemedicine revolution

2.3.1. In COVID-19

During COVID-19 pandemic organisations have accepted that telemedicine has a key role, developed their departments to facilitate telemedicine [11]. Current and evolving telecommunication

technologies play a key role in exchange of valid information for diagnosis and management of diseases and injuries. The main modalities for remote consultations include telephone consultations, virtual fracture clinics and video consultations [22–24]. These innovations are going to be main-stay in how we deliver health care in the future.

2.3.2. Face to face consultation is common in India and has and has its own drawback

Recently Telemedicine or delivery of health care services using information or communication technology is evolved in India due to COVID 19. Telemedicine set to transform healthcare in a post-Covid-19 world. The Government of India has recently launched the e-sanjeevani OPD, a national tele-consultation service, as mandatory for health-care 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 [25]. Recently, The Indian Medical Association has adopted the necessary regulatory frameworks for supporting wide adoption of telemedicine and issued an advisory for its use in few situations. When the pandemic will end, doctors will prefer to see patients directly, but at the same time due to increased experience in tele-medicine will help them to see patient if they skip the doctors' visits.

2.4. Patient perception and factors

There is a myriad of medical conditions that are self-limiting. E.g. traditionally orthopaedic doctors have been receiving referrals before the pandemic and had to counsel patients regarding these conditions (e.g. patellar tendinitis, ganglion swellings) [26]. During the pandemic, patients with those conditions were given advices over the phone and guided to online resources by which they were satisfied. We believe patients with those conditions would benefit from the education and positive message that can be provided by accessing designated online websites and online physiotherapy services. This saves plenty of consultation time and help offload our health care systems and outpatient services.

2.5. Medical education

Teaching is a mandatory part of medical training in all specialties. Different online applications have been used to continue delivering teaching sessions to trainees at variable levels. This has proven to be more convenient, flexible and bringing education. Also, this has given us the chance to meeting international interesting people and gain real world skills at our homes. Smartphone technology allows conferences, seminars, workshops, and other forms of online teachings [15,27,28].

Webcams captured hospital rounds; 3D images replaced cadavers, Zoom classes, virtual simulators, webcasting, online chat-rooms, virtual dissection, E-anatomy with Virtual Reality [29–31].

2.6. Research and publications

The global lockdown during this pandemic has given a unique opportunity to the researchers and clinicians to complete their pending paper publications and research works. There have been an unprecedented number of publications during the peak of the COVID-19 pandemic across all the medical journals of the world [32]. This positive trend might continue in future and help the healthcare industry to benefit from these research and innovations, including finding effective means of dealing with the future epidemics and pandemics.

3. Conclusion

Human crisis like COVID-19 pandemic has also offered some unique opportunities for the healthcare sector. It has allowed us to revisit the healthcare delivery. Rationalizing and optimizing the available resources during such crisis are some of the most important lessons learnt from this crisis. Although, there has been severe disruption in the healthcare delivery during this time globally, but several positives have also come out of it viz., the effective use of telemedicine, importance of personal hygiene, and the importance of infection control. The virtual means of teaching, educating, and sharing knowledge has now become popular and acceptable. The research and publications have also seen a significant rise during these difficult times.

Declaration of competing interest

None.

References

- [1] Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020 Feb 15;395(10223):497–506.
- [2] World Health Organisation Dashboard Coronavirus. <https://experience.arcgis.com/experience/685d0ace521648f8a5beeee1b9125cd>; 2020. accessed 17 May 2020.
- [3] Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-nCoV/index.html>; 2020.
- [4] Yang X, Yu Y, Xu J, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med* 2020. [https://doi.org/10.1016/S2213-2600\(20\)30079-5](https://doi.org/10.1016/S2213-2600(20)30079-5). published online Feb 21.
- [5] World Health Organization. Coronavirus disease (COVID-19) advice for the public. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>; 2020.
- [6] Haleem A, Javaid M, Vaishya R. Effects of COVID 19 pandemic in daily life [published online ahead of print, 2020 Apr 3]. *Curr Med Res Pract* 2020. <https://doi.org/10.1016/j.cmrp.2020.03.011>.
- [7] World Economic Forum. The economic, geopolitical and health impacts of COVID-19. <https://www.weforum.org/agenda/2020/03/the-economic-geopolitical-and-health-consequences-of-covid-19/>. Accessed 13 May 2020.
- [8] [Internet] The BMJ Today: the versatility of medical careers. *The BMJ*; 2014 [cited 2020 May 16]. Available from: <https://blogs.bmj.com/bmj/2014/03/21/the-bmj-today-the-versatility-of-medical-careers/>.
- [9] NHS England. Guidance on supply and use of PPE. <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/PPE-Letter-FINAL-20-March-2020-updated-on-22-March-2020.pdf>; 2020. accessed 18 May 2020.
- [10] Health workers are the frontline soldiers against COVID-19. Let's protect them | Africa Renewal [Internet]. [Cited 2020 May 16]. Available from: <https://www.un.org/africarenewal/web-features/coronavirus/health-workers-are-frontline-soldiers-against-covid-19-let%E2%80%99s-protect-them>.
- [11] NHS England and NHS Improvement. Attend anywhere. https://england.nhs.attendanywhere.com/resourcecentre/Content/Public_Topics/Discover.htm. accessed 18 May 2020.
- [12] Iyengar K, Vaish A, Toh E, et al. COVID-19 and remote consulting strategies in managing trauma and orthopaedics. *Postgrad Med* (Published Online First: 13 May 2020). <https://doi.org/10.1136/postgradmedj-2020-137917>.
- [13] Ghosh A, Gupta R, Misra A. Telemedicine for diabetes care in India during COVID19 pandemic and national lockdown period: guidelines for physicians. *Diabetes Metabol Syndr: Clin Res Rev* 2020. <https://doi.org/10.1016/j.dsx.2020.04.001>.
- [14] Ghosh A, Dutta K, Tyagi K, Gupta R, Misra A. Roadblock in application of telemedicine for diabetes management in India during COVID19 pandemic. *Diabetes Metabol Syndr: Clin Res Rev* 2020. <https://doi.org/10.1016/j.dsx.2020.05.010>.
- [15] Iyengar K, Upadhyaya GK, Vaishya R, Jain V. COVID-19 and applications of smartphone technology in the current pandemic. *Diabetes & Metabolic Syndrome. Clin Res Rev* 2020;14(Issue 5):733–7. <https://doi.org/10.1016/j.dsx.2020.05.033>.
- [16] Seda G, Parrish JS. Augmenting critical care capacity in a disaster. *Crit Care Clin* 2019 Oct;35(4):563–73.
- [17] Iyengar K, et al. Challenges and solutions in meeting up the urgent requirement of ventilators for COVID-19 patients. *Diabetes & Metabolic Syndrome. Clin Res Rev* 2020;14(Issue 4):499–501. <https://doi.org/10.1016/j.dsx.2020.04.048>.
- [18] Chatterje P. Gaps in India's preparedness for COVID-19 control. *Lancet Infect Dis* 2020 May;20(5):544. [https://doi.org/10.1016/S1473-3099\(20\)30300-5](https://doi.org/10.1016/S1473-3099(20)30300-5).

- Epub 2020 Apr.
- [19] The Lancet. India under COVID-19 lockdown. *Lancet* 2020;395(10233):1315. [https://doi.org/10.1016/S0140-6736\(20\)30938-7](https://doi.org/10.1016/S0140-6736(20)30938-7).
- [20] Government of India. Transforming India. <https://transformingindia.mygov.in/aatmanirbharbharat/>.
- [21] Haider S. Coronavirus | USAID to fund 200 ventilators for India to help tackle COVID-19. <https://www.thehindu.com/news/national/usaaid-to-fund-200-ventilators-for-india-to-help-tackle-covid-19/article31612220.ece>. Accessed on 4 June 2020.
- [22] Iyengar K, El-Nahas W. A brief guide to telephone medical consultation. *Br J Healthc Manag* 2020. <https://doi.org/10.12968/bjhc.2020.0032>.
- [23] Logishetty K, Subramanyam S. Adopting and sustaining a Virtual Fracture Clinic model in the District Hospital setting: a quality improvement approach. *BMJ Qual Improv Rep* 2017;6(1):u220211. w7861.
- [24] Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. *BMJ* 2020;368:m998. <https://doi.org/10.1136/bmj.m998>. Published 2020 Mar 12.
- [25] Government of India. eSanjeevani. An integrated telemedicine solution. <https://esanjeevani.com/>.
- [26] Mayne R, Thacker M. Jumping off the merry-go-round. 2020. May 16 [cited 2020 May 16]; Available from: <https://www.bmj.com/rapid-response/2011/11/02/jumping-merry-go-round>.
- [27] Advantages and disadvantages of online courses | montgomery college, Maryland [internet] [Cited 2020 May 16]. Available from: <https://www.montgomerycollege.edu/academics/online-learning/distance/advantages-and-disadvantages-online-courses.html>.
- [28] Sandars J, Correia R, Dankbaar M, de Jong P, et al. Twelve tips for rapidly migrating to online learning during the COVID-19 pandemic. *MedEdPublish* 2020;9(1):82. <https://doi.org/10.15694/mep.2020.000082.1>.
- [29] Naseri A, Hosseini MS. Do not neglect the children: considerations for COVID-19 pandemic. *Indian Pediatr* 2020 Apr 26. pii: S097475591600165.
- [30] Darras KE, Spouge R, Hatala R, Nicolaou S, Hu J, Worthington A, Krebs C, Forster BB. Integrated virtual and cadaveric dissection laboratories enhance first year medical students' anatomy experience: a pilot study. *BMC Med Educ* 2019 Oct 7;19(1):366. <https://doi.org/10.1186/s12909-019-1806-5>.
- [31] Cleveland clinic creates E-anatomy with virtual reality. <https://newsroom.clevelandclinic.org/2018/08/23/cleveland-clinic-creates-e-anatomy-with-virtual-reality/>. [Accessed 23 August 2018].
- [32] Srinivas SBK, Vaishya R, Vaish A. Unprecedented surge in Publications related to COVID-19 in the first three months of Pandemic. *J Clin Orthop Trauma* 2020. <https://doi.org/10.1016/j.jcot.2020.04.030>.