

Case Report

Pulse Oximetry is Essential in Home Management of Elderly COVID-19 Patients

Md. Abdullah Al Harun¹, Mohammad Murad Hossain², Mohammad Anwarul Bari³, Nazmul Ahsan Siddiqi Rubel⁴, Mohammad Enamul Karim⁵, Nadia Siddiquee⁶, Mohammad Delwar Hossain⁷, Farhana Sultana⁸, Ahmmad Taous⁹, AKM Monwarul Islam¹⁰, Salma Khatun¹¹, AHM Afzalul Haque¹², Mohammad Mahbub-UI Haque¹³, KM Mamun Murshed¹⁴, Syed Atiqullah¹⁵, Abu Mohammad Ekramul Hoque¹⁶, Mohammad Abdullah¹⁷

Abstract

Background: Coronavirus disease 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2) is in Pandemic form and has affected people of 215 countries. It produces symptoms like fever, cough, shortness of breath, sore throat, headache, loss of taste, smell or appetite and many other rare symptoms. But the most important symptom is shortness of breath due to hypoxia. In a normal individual oxygen saturation (SpO₂) is at least 95% and patient feels shortness of breath when SpO₂ falls below 90% with some exception. SARS-CoV-2, a newly emergent coronavirus has the peculiarity to produce silent hypoxia, meaning SpO₂ < 90% or less like 80%, 70%, 60% without shortness of breath. Silent hypoxia can be diagnosed by monitoring SpO₂ with pulse oximeter. For management of COVID-19, early symptoms like fever & cough, SpO₂ should be monitored by pulse oximeter, followed by immediate correction of hypoxia by O₂ supplementation and prophylactic oral or injectable anticoagulant to prevent thromboembolism and thus death rate can be reduced.

Case summary: A 72-year-old man presented with the complaints of fever and headache followed by cough, fatigue, anorexia, loss of taste and appetite in next few days but no shortness of breath. The patient was clinically diagnosed as a case of COVID-19 & positive result of Real time-Polymerase Chain Reaction (RT-PCR) test confirmed the diagnosis. From the first day, SpO₂ was regularly monitored with pulse oximeter and SpO₂ on day 1, it was 96-98%. On day 8, SpO₂ fell to 89-93%, pulse 96/min, respiratory rate >30/min, temperature 101° F, taste sensation was reduced. According to sign and symptoms, the patient was diagnosed as COVID-19 with severe pneumonia. Management was started at home with continuous monitoring, lying in prone position for 5-6 hours/day, supplemental oxygenation to maintain level of SpO₂ between 94-96%, injectable anticoagulant enoxaparin to prevent venous thromboembolism (VTE) and disseminated intravascular coagulation (DIC) was given. Prophylactic antibiotics and symptomatic treatment were also given.

Results: According to this case report, patient's SpO₂ was monitored by pulse oximeter on first day; on day 08, SpO₂ fell to 89-93% & on day 10, further dropped to 85-88% which

**Details of the authors and contributors included at the end of the article.

Address of Correspondence: Md. Abdullah Al Harun, Assistant Professor (ENT), Shaheed Suhrawardy Medical College, Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh, +8801678139788, Email: harun.dr.99@gmail.com

indicated severe pneumonia but there was no complaint of breathlessness as it was silent hypoxia. Sometimes the patient spent 30 minutes or more in toilet and SpO₂ used to fall to 82-83% without any subjective shortness of breath but with only mild heaviness of chest and cough. Therefore SpO₂ monitoring by pulse oximeter is essential in early diagnosis of silent hypoxia. Correction of hypoxia by supplemental oxygenation and prevention of VTE and DIC by using anticoagulant was the mainstay of treatment and patient had significant improvement on day 14. The patient was managed completely at home except X-ray being done in a hospital.

Conclusion: *Fall of SpO₂ in COVID-19 i.e. hypoxia (usually present as shortness of breath) or silent hypoxia can be diagnosed early by pulse oximeter or smart phone pulse oximetry apps. Early management by isolation, supplemental oxygenation and oral/injectable anticoagulation can prevent further events like Acute Respiratory Distress Syndrome (ARDS), respiratory failure followed by multiple organ failure (that may cause death). The authors advocate further clinical trial and research.*

Keywords: *Pulse oximetry, Home management, COVID-19, Silent hypoxia, Oral anticoagulant.*

Introduction:

Today June 15, 2020, completed 100 days of attack by Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2) in Bangladesh. SARS-CoV-2 virus causes Coronavirus disease 2019 (COVID-19) have turned into a pandemic. 1st case of COVID-19 was recognized on December 2019 in Wuhan, the capital of Hubei, China¹⁻⁴. Three cases of COVID-19 was 1st recognized on March 08, 2020 and reported by the epidemiology institute, IEDCR in Bangladesh. Till today 90,619 people have been affected and 1,209 died in Bangladesh and 80,64,416 persons have been affected whereas 4,37,207 died in 215 affected countries of the world⁵.

Affected cases are confirmed by Real time-Polymerase Chain Reaction (RT-PCR) test was done for SARS-CoV-2 (COVID-19) and positive result confirmed the diagnosis. There may be many cases having COVID-19 like clinical symptoms without going for RT-PCR test, so total number of COVID-19 cases may be more. COVID-19 infected patients develop only mild (40%) or moderate

(40%) symptoms and approximately 15% develop severe disease that requires oxygen (O₂) supplementation and 5% have critical diseases with complications such as respiratory failure, ARDS, sepsis and septic shock, thromboembolism and/or multiple organ failure including acute kidney injury and cardiac injury. Most of the SARS-CoV-2 infected patients are men (73%)². Older age, smoking, co-morbidities such as diabetes, hypertension, cardiac disease, chronic lung disease are the risk factors for severe disease^{4,6,7}. Severe coronavirus disease is commonly complicated with coagulopathy and DIC may exist in the majority of death^{8,9}.

Common symptoms of COVID-19 diseases are fever, cough, fatigue, anorexia, shortness of breath, myalgias. Other non-specific symptoms such as sore throat, nasal congestion, headache, diarrhoea, nausea and vomiting, loss of taste, appetite & smell may present in some cases^{2,4}. Shortness of breath occurs due to hypoxia which means SpO₂ < 90% but with COVID-19 disease SpO₂ reduced below normal level may be down to 70%, 60% or 50% but patient had

no feeling of breathlessness.^{10,11} He can continue his own job without any breathing problem which makes the patient more vulnerable.

SpO₂ is an essential element in the management and understanding of patient's care which measures how much haemoglobin is currently bound to oxygen compared to how much haemoglobin remains unbound.¹² A pulse oximeter is a noninvasive medical device placed over a person's finger to monitor blood oxygen saturation.^{13,14} It is routinely used in operation theatre, Intensive Care Unit (ICU) and postoperative ward in hospital. Investigation results other than RT-PCR test like normal or low total count of WBC, lymphopenia, neutrophil lymphocyte ratio, high C-Reactive Protein(CRP), low procalcitonin, significant elevation of D-Dimer & S. Ferritin level, associated with bilateral pneumonia in CXR or ground glass opacities (GGO) and Crazy paving appearance in CT scan of chest suggest presence of COVID-19 during this pandemic situation.¹⁵

Till today O₂ supplementation to correct hypoxia and prevention of VTE and DIC by using anticoagulant is the mainstay of treatment for COVID-19. Other advice like lying in prone position, mild breathing exercise, adequate nutrition & symptomatic treatment like antibiotics to prevent secondary infections, paracetamol for fever, montelukast and other medications are used during management. For home management of COVID-19 patients, proper caring by relatives or a professional nurse and required medication should be confirmed.⁶

This case study focuses on early diagnosis of hypoxia without shortness of breath by pulse oximeter which monitors SpO₂, also can be monitored by pulse oximetry apps

installed on smart mobile phones. When SpO₂ is 94% or less, O₂ supplementation should be given to maintain SpO₂ above 94%⁴ and oral anticoagulant apixaban/rivaroxaban or injectable Low Molecular Weight Heparin (LMWH) Enoxaparin may be given to prevent VTE or DIC in home management.

Case Presentation:

A 72-year-old man, father of the first author staying with him at the same home developed symptoms like fever and headache on May 21, 2020 [day 1 of COVID-19 (D-1)]. First author developed symptoms of COVID-19 on May 13, 2020 and confirmed by RT-PCR test on May 16, 2020. The first author was isolated in a room with attached toilet and for contact tracing RT-PCR test was done to patient (father of 1st author), patient's wife (mother of 1st author) and 6th author (wife of 1st author) on May 21, 2020 and all RT-PCR test result became positive. As RT-PCR test is a confirmatory test, patient was diagnosed as a case of COVID-19.

The patient is hypertensive controlled on drug and according to risk factors for COVID-19 advised by World Health Organization (WHO) patient's age being more than 60 years, had co-morbidity like hypertension, so the patient was in risk group and monitored from D-1. Pulse oximeter was arranged at home to monitor SpO₂ which was 96-98%. From D-1 patient's SpO₂, temperature, pulse, respiratory rate & taste sensation was routinely monitored 3 times a day. Patient gradually developed cough, fatigue, anorexia, nausea, nasal congestion, loss of appetite & taste which gradually deteriorated. He had no sign of shortness of breath, sore throat, diarrhoea or loss of smell (Tabel:I).

Table - II :
Laboratory investigations

Investigation	Unit	May 21 (D-1)	May 28 (D-8)	May 31 (D-11)	June 5 (D-16)	June 9 (D-20)
RT-PCR test for SARSCOV2	Positive/Negative	Positive	–			Negative
CRP	mg/L	–	210	240	90	12
Neutrophil	%	–	70	80	70	65
Lymphocyte	%	–	25	16	19	27
WBC	K/ μ L	–	7.60	8.00	7.56	8.60
ESR	mm in 1 st hour	–	85	100	112	112
D-Dimer	μ g/ml	–		0.45	1.6	0.46
S. Ferritin	ng/ml	–		647	616	455
Na ⁺	mmol/L	–	139	137	140	–
K ⁺	mmol/L	–	2.9	3.3	3.9	–
Cl ⁻	mmol/L	–	106	106	109	–
TCO ₂	mmol/L	–	21	20	22	–
RBS	mmol/dL	–	7.2	–	–	–
S. Creatine	mg/dl	–	1.13	–	–	–
ALT	U/L	–	29	–	–	–
INR	–	–	-	–	–	1.21
Troponin-I	ng/ml	–	<0.01	–	–	–
Dengue AbligM	Positive/Negative	–	Negative	–	–	–
Dengue AbligG	Positive/Negative	–	Positive	–	–	–
Urine R/M/E	Pus cell/HPF	–	5-7	–	–	–

D = Number of Day of COVID-19

June 6, 2020 (D-16). During continuous supplemental oxygenation most of the time patient used non rebreather mask except during taking food & sleep. At that time patient used nasal cannulas. On May 30, 2020 (D-10) SpO₂ fell to 85-87% and from next day (D-11) SpO₂ gradually improved. On June 5, 2020 (D-16), the patient's condition was stable and demand of O₂ supplementation gradually reduced. Patient needed only 1 liter per minute (L/min) O₂ to maintain saturation 94-96%. O₂ supplementation from May 28, 2020 to June 10, 2020 shown in Table III.

On June 1, 2020 (D-12) CXR showed resolving consolidation in the mid zone of right lung with bilateral basal pneumonitis compared to previous one. On June 5, 2020 (D-16), temperature 98° F, pulse- <80 beat/min, respiratory rate <20/min, taste sensation reverse to normal & investigations showed CRP- 90.0 mg/L, WBC- 7.56 K/ μ l, neutrophil- 70%, lymphocyte- 19%, ESR 112 mm in 1st hour, D-dimer 1.60 μ g/ml, S. Ferritin-616 ng/ml and S. electrolytes within normal level. On June 9, 2020 (Day-20) patient felt symptoms free with SpO₂ 96-98%, P-74/min, respiratory rate - <20/min, temperature - normal, taste sensation reverted to normal.

Table III :
O₂ Supplementation to maintain SpO₂>94% during hypoxia (Target SpO₂ was 94-96%)

Date	Day	SpO ₂	Average SpO ₂	Supplied amount of O ₂ (L/min)	
		Without O ₂	with O ₂	NRB	Nasal Cannula
May 27, 2020	7	93-95%	No need	No need	No need
May 28, 2020	8	89-93%	94-96%	Not used	2
May 29, 2020	9	88-91%	94-96%	2	3
May 30, 2020	10	85-88%	94-96%	3.5	5
May 31, 2020	11	87-89%	94-96%	3	5
June 01, 2020	12	89-92%	94-96%	3	3
June 02, 2020	13	91-94%	94-96%	2	3
June 03, 2020	14	92-94%	94-96%	2	2.5
June 04, 2020	15	92-95%	95-97%	1.5	2
June 05, 2020	16	93-96%	95-98%	1	2
June 06, 2020	17	94-97%	95-98%	1 (50% day& bedtime)	1 (bedtime)
June 07, 2020	18	94-97%	95-98%	1 (bedtime)	1 (bedtime)
June 08, 2020	19	94-97%	95-99%	1 (bedtime)	1 (bedtime)
June 09, 2020	20	95-98%	96-99%	1(50% of bedtime)	1 (50% of bedtime)
June 21, 2020	21	96-98%	No need	No need	No need

SpO₂= oxygen saturation in blood, L/min= liter per minute, NRB= non rebreather mask



Fig-1: Patient lying in prone position (5-6 hours/day), continuous oxygenation from oxygen cylinder and monitoring with pulse oximeter.

On RT-PCR test COVID-19 result came negative, CXR became normal and laboratory investigation reports within normal limit, except ESR & S. Ferritin (Table II).

During management, monitoring of SpO₂ for 24 hours was difficult to maintain. During toilet use, patient refused to take O₂ and after coming from toilet, SpO₂ used to go down to 82-83% for few minutes due to absence of O₂ supply which had to immediately corrected by higher flow of oxygen than earlier. Ecchymosis developed associated with mild pain in the injection site of paraumbilical region (Fig: II) due to Enoxaparin which was gradually diminished.



Fig.-2: *Ecchymosis in the paraumbilical region of the abdomen due to injection Enoxaparin.*

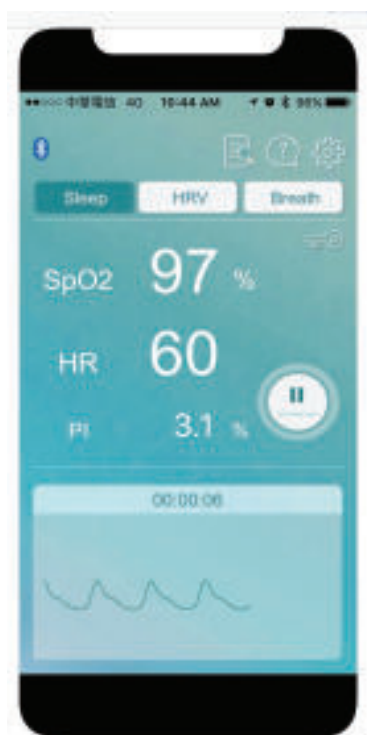


Fig 3: *SpO₂ and heart rate (pulse) in smart phone*

Discussion:

COVID-19 was declared as pandemic by WHO on March 11, 2020 caused by SARS-

CoV-2 virus is at exponentially rising state across the globe. Bangladesh is also facing this highly transmissible zoonotic disease with community transmission across the country. In Bangladesh it was declared as pandemic on April 16, 2020.¹⁶ Patients of COVID-19 develops clinical symptoms like fever (83-99%), cough (59-82%), fatigue (44-70%), shortness of breath (31-40%), anorexia (40-84%), myalgias (11-35%). Rarely, patient may also present with sore throat, nasal congestion, malaise, headache, diarrhoea, nausea and vomiting, loss of smell, taste or appetite⁴. Out of these symptoms most dangerous is shortness of breath (31-40%) and approximately 15% of total cases develop severe diseases and need O₂ supplementation. Patients with severe disease develops shortness of breath and hypoxia about one week after onset of early symptoms.¹⁷ Age more than 60 years, habit of smoking and underlying co-morbidities such as diabetes, hypertension, cardiac disease, chronic renal disease, cerebrovascular disease, chronic lung disease, immunosuppression and cancer may have been associated with higher mortality.⁴

In this pandemic situation, arrangement of hospital admission for all COVID-19 patients may not be possible. In a normal healthy individual SpO₂ should be 95% or above and normally he feels breathlessness or respiratory distress when SpO₂<90%¹⁸. But in COVID-19, due to SARS-CoV-2 infection, SpO₂ falls down very slowly and body adopts with that saturation, so patient does not feel breathlessness down to 70%, 60%, 50% or even lower¹⁰. Such unusual clinical picture has emerged in some patients with SARS-CoV-2 virus infection, developed hypoxia that is out of proportion of the patient's symptoms. This has been called silent hypoxia¹⁹. It is also termed as happy hypoxia because the

patient feels well with very low SpO₂. But suddenly he present with shortness of breath along with severe hypoxia which causes acute respiratory failure followed by multiple organ failure which may cause death. So, at home early SpO₂ monitoring can contribute in management of COVID-19, reduce mortality and reduce the burden on hospital capacity in this pandemic situation.

The patient's condition was being assessed and management was started at early stage, but the disease process continued to progress and severe pneumonia developed on May 28, 2020 (Day 8). Patient was monitored with pulse oximeter to maintain SpO₂ within 94-96% and O₂ supplementation at home was ensured from Bangladesh ENT Hospital Ltd.

Ensuring O₂ supply is the main challenge in home management of COVID-19 patient as well as in isolation ward. O₂ supplementation can be ensured from O₂ cylinder or O₂ concentrator. Concentrator can produce O₂ from atmospheric air may be up to 10 L/min. For O₂ delivery, patients can use nasal cannula, face mask or non rebreather mask (NRB). These are low flow O₂ delivery devices in which nasal cannula supply up to 6 L/min (FiO₂ up to 50%), by simple mask up to 10 L/min (FiO₂ up to 60%) and NRB delivered O₂ up to 15 L/min (FiO₂ up to 100%)¹⁵. To maintain targeted SpO₂, NRB should be preferred. So authors' advice to use NRB most of the time for O₂ delivery and nasal cannulas should be used during taking food and sleep also for patients who produce repeated productive cough.

Other than pulse oximeter, patient's condition was monitored with total count of WBC and ratio of neutrophil to lymphocyte. Decreased number of lymphocytes or the ratio of neutrophil to lymphocyte more than 3.5 is prognostically poor sign. Rapid and significantly elevated CRP indicates

possibility of secondary infection. D-dimer is a biomarker of fibrin formation and degradation which might help in early recognition of these high risk patients and also predict outcome.¹⁵ D-dimer and Ferritin are elevated in severe cases of pneumonia, which is a potential risk factor for poor prognosis.¹⁴

When SpO₂ falls below 94%, prophylactic injectable anticoagulant LMWH enoxaparin was given from the first day of severe pneumonia to prevent VTE & DIC which prevent further damage of lungs parenchyma. Enoxaparin given in right and left side of umbilicus on alternative days, causes ecchymosis, pain & indurations at the site of injection. Another direct oral anticoagulant (DOAC) tablet rivaroxaban 10mg daily which was started on June 7, 2020 (Day-18) for next 10 days. Elevated D-dimer indicates increased risk of abnormal blood clotting and its level above 1µg/ml was a strong and independent risk factor for death in these patients.²⁰⁻²⁴ Patient with D-dimer more than six times of the upper limit of normal level comprise in a higher proportion of severe cases.²⁴ Early anticoagulation is necessary to prevent propagation of microthrombi at disease presentation and anticoagulation may be associated with decreased mortality.²⁵ Injectable LMWH enoxaparin is the best choice of anticoagulant for hospital admitted patients due to its anti inflammatory action.²⁶ DOAC drugs are oral selective Factor Xa inhibitors and decreases thrombin generation and blood clot formation.^{18,27} The advantages of DOAC drugs like apixaban/ rivaroxaban are: they can be given as fixed doses, do not require monitoring, rapid onset of action, high oral bioavailability when being taken with food, low cost & self medication.¹⁸ In comparison LMWH enoxaparin, apixaban/ rivaroxaban has no anti-inflammatory action

and using with antiviral drugs cause high rise of plasma level of apixaban/rivaroxaban which increases haemorrhagic risk, so it should not be used with antiviral drugs.^{28,29} The incidence of VTE is low in Asian population and therefore routine VTE is not frequently used.²⁴ As DOAC drugs like apixaban/rivaroxaban can given in oral fixed doses, do not require monitoring, rapid onset of action, cost effective the authors suggest those as prophylactic anticoagulant when SpO₂ starts to fall down both in home & hospital isolation ward management. The authors advocate further research & trial on it.

Other drugs were taken like co-amoxiclav to prevent secondary bacterial infection, paracetamol to reduce body temperature, famotidine as antiulcerant, sulbutamol inhaler for bronchodilatation, montelukast, antihistamine, acetylcysteine and domperidone according to symptoms.

In case of home management, main challenges in providing proper care are risk of the caregivers being infected by the virus, monitoring of vital parameters, ensuring continuous oxygen supply, laboratory investigations, X-ray and subcutaneous injection of LMWH enoxaparin. The reported case of home management of COVID-19 was managed successfully in presence of 1st & 6th author except X-ray which was done in ShSMCH but SpO₂ was maintained to 94-96% level by continuous supplemental oxygen during transportation on June 1, 2020.

From the above discussion it is clear that the patient having silent hypoxia which can be early diagnosed by monitoring of SpO₂ with pulse oximeter. Early management of COVID-19 with maintenance of oxygen saturation within 94-96% and anticoagulant prevent complication of disease.

As in a pandemic situation lack of hospital bed availability and patients with anorexia, diarrhoea, nausea, vomiting, loss of smell & taste sensation, weakness with change of regular diet and environment grossly affects the improvement of patient. So, elderly COVID-19 patients are being better managed at home other than hospital (if possible).

Recommendations from the authors:

From the experience of home management of an elderly COVID-19 patient and after reviewing the related literatures, the authors have some recommendation which can be considered by the policy makers as well as by the physician for management of COVID-19.

1. Patients who develop most common diagnostic symptoms of COVID-19 like fever (83-99%) and cough (59-82%), their SpO₂ must be monitored routinely to diagnose silent hypoxia without symptoms of shortness of breath (31-40%).
2. Pulse oximeter is essential for monitoring of SpO₂ level in COVID-19 which is the main tool for diagnosis and management of silent hypoxia.
3. Pulse oximetry apps in mobile phone which already exist in some higher end smart mobile phone can help in early diagnosis of silent hypoxia¹³.
4. Oral anticoagulant apixaban/rivaroxaban can be started when SpO₂ gradually deteriorating from its baseline (normal at least 95%) as prophylaxis to prevent VTE and DIC. Previous bleeding disorder should be excluded and concomitant treatment with antiviral drugs should be avoided.
5. Home management is equally effective like management in hospital isolation ward if SpO₂ can be monitored by pulse

oximeter, O₂ supply ensured, medications, home service of laboratory investigation & CXR can be ensured. In this pandemic situation proper implementation of home management can save a lot of lives as availability of hospital bed is limited.

These recommendations need further research and trial to establish the observation of the authors.

Conclusion:

The symptoms caused by COVID-19 range from mild upper respiratory symptoms to multiple organ failure complicated by severe hypercoagulability state.³ These complications ultimately cause death. To reduce death early diagnosis of silent hypoxia is strongly recommended by the authors. Pulse oximeter can diagnose hypoxia by measuring SpO₂ with or without breathlessness. Pulse oximetry apps in smart mobile phone can be a good alternative of pulse oximeter. Patients with older age, habit of smoking & co-morbidities are in risk group for severe diseases of COVID-19³⁰. So, our recommendation is that, in this pandemic situation when elder patient feels fever, it should be clinically diagnosed as COVID-19 without waiting for RT-PCR test result and SpO₂ should be monitored 3 times a day to diagnose hypoxia. First oral anticoagulant apixaban/rivaroxaban may be started as prophylaxis to prevent VTE & DIC if there is no history of bleeding disorder & patient not taking any antiviral drugs²⁸. The author's observation needs further research & trial which may contribute in management guideline of COVID-19.

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Details of the Authors

1. Assistant Professor (ENT), Shaheed Suhrawardy Medical College, Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh, Cell: +8801678139788, Email: harun.dr.99@gmail.com
2. Associate Professor (Medicine); Dhaka Medical College, Dhaka, Bangladesh
3. Associate Professor (Medicine); Sir Salimullah Medical College, Dhaka, Bangladesh
4. Junior Consultant (Anaesthesia), ICU Consultant, Kurmitola General Hospital, Dhaka, Bangladesh
5. Assistant Professor (Gastroenterology), Sheikh Russel National Gastroenterology Institute and Hospital, Dhaka, Bangladesh
6. Senior Medical Officer, Department of Physical Medicine and Rehabilitations, BIRDEM General Hospital, Shahbag, Dhaka, Bangladesh
7. Professor & Head of Department (Respiratory Medicine), BIRDEM General Hospital and Ibrahim Medical College, Shahbag, Dhaka, Bangladesh
8. Assistant Professor (Radiology and imaging), Shaheed Suhrawardy Medical College Hospital, Sher E Bangla Nagar, Dhaka, Bangladesh
9. Associate Professor (ENT), Pabna Medical College, Pabna, Bangladesh

10. Associate Professor (Cardiology), National Institute of Cardiology, Sher-E-Bangla Nagar, Dhaka, Bangladesh
11. Medical Officer (Radiology & Imaging), Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh
12. Assistant Professor (Urology), Dhaka Medical College, Dhaka, Bangladesh
13. Assistant Professor (Anaesthesiology), ICU Consultant, Mugda Medical College, Dhaka, Bangladesh
14. Associate Professor (ENT) & Additional Director, Shaheed Suhrawardy Medical College, Dhaka, Bangladesh
15. Assistant Professor, Sheikh Hasina Medical College, Tangail, Bangladesh
16. Clinical Pathologist, Shaheed Suhrawardy Medical College Hospital, Sher E Bangla Nagar, Dhaka, Bangladesh
17. Professor (Otolaryngology), Principal and Head of Department, Popular Medical College, Dhaka, Bangladesh
3. From Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka, Bangladesh- Md. Abul Hasnat Joarder, Professor (Otolaryngology); Abu Sadique Abdullah, Consultant (Cardiology)
4. From Bangladesh ENT Hospital Ltd, Sobhanbag, Dhaka, Bangladesh- Khabiruddin Ahmed, Professor (Otolaryngology); Mohammad Zillur Rahman, Professor (Otolaryngology)
5. From Dhaka Medical College, Dhaka, Bangladesh -Mohammad Shaharior Arafat Assistant Professor(ENT); Md. Farooque-Z-Zaman, Registrar (Respiratory Medicine)
6. From Kurmitola General Hospital, Dhaka, Bangladesh- Rumana Sultana, Junior Consultant (Anesthesia), ICU Consultant.
7. From National Institute of ENT, Tejgaon, Dhaka, Bangladesh, Zakaria Sarker, Associate Professor (ENT)
8. From Popular Medical College, Dhaka, Bangladesh- Ahmed Raquib, Associate Professor (ENT)

Contributors

1. All authors provided critical feedback on the manuscript
2. From Shaheed Suhrawardy Medical College & Hospital Sher-E-Bangla Nagar, Dhaka, Bangladesh- Uttam Kumar Barua, Director & Professor (Respiratory Medicine); ABM Maksudul Alam, Principal & Professor (Anesthesia); Md. Shahadat Hossain, Vice Principal & Professor (Physical Medicine & Rehabilitation); Md. Shohidul Islam, Associate Professor (Radiology and Imaging); Md. Shohidul Islam, Assistant Professor (Anesthesia).
9. From University of Dhaka, Dhaka, Bangladesh -Mamun Or Rashid, Professor, Department of Computer Science and Engineering
10. From Tiger-park Limited, Dhaka, Bangladesh - Md. Momenul Islam, Head of Research and development

References

1. Ahn DG, Shin HJ, Kim MH, Lee S, Kim HS, Myoung J, Kim BT, Kim SJ. Current Status of Epidemiology, Diagnosis, Therapeutics, and Vaccines for Novel Coronavirus Disease 2019 (COVID-19). *Journal of microbiology and biotechnology* 2020;30(3):313-324.

2. Mannan N, Akram A. Variation of Clinical Features of Covid19 Patients. *Bangladesh Journal of Infectious Diseases* 2020;7(Suppl_1):S54-S57.
3. Turshudzhyan A. Anticoagulation Options for Coronavirus Disease 2019 (COVID-19)-Induced Coagulopathy. *Cureus* 2020;12(5):e8150.
4. World Health Organization. Clinical management of COVID-19: interim guidance. <https://www.who.int/publications/i/item/clinical-management-of-covid-19>, 2020.
5. IEDCR. Bangladesh Corona Poristithi. Prothom Alo 16 June 2020, 2020:1.
6. Kunz R, Minder M. COVID-19 pandemic: palliative care for elderly and frail patients at home and in residential and nursing homes. *Swiss medical weekly* 2020;150:w20235.
7. Morley JE, Vellas B. COVID-19 and Older Adult. *The journal of nutrition, health & aging* 2020;24(4):364-365.
8. Tang N, Bai H, Chen X, Gong J, Li D, Sun Z. Anticoagulant treatment is associated with decreased mortality in severe coronavirus disease 2019 patients with coagulopathy. *Journal of thrombosis and haemostasis* : JTH 2020;18(5):1094-1099.
9. Kollias A, Kyriakoulis KG, Dimakakos E, Poulakou G, Stergiou GS, Syrigos K. Thromboembolic risk and anticoagulant therapy in COVID-19 patients: emerging evidence and call for action. *British journal of haematology* 2020;189(5):846-847.
10. Tanenbaum M. 'Happy hypoxia' mystifies experts in some COVID-19 patients <https://www.phillyvoice.com/happy-hypoxia-covid-19-low-blood-oxygen-coronavirus-mystery/>.
11. Couzin-Frankel J. The mystery of the pandemic's 'happy hypoxia'. *Science* (New York, NY) 2020;368(6490):455-456.
12. Hafen BB, Sharma S. Oxygen saturation. In: *Treasure Island (FL)*, ed. StatPearls [Internet]: StatPearls Publishing; 2020.
13. Schutz SL. Oxygen saturation monitoring by pulse oximetry. In: Lynn-McHale DJ, Carlson KK, eds. *AACN procedure manual for critical care*. 4th ed: W. B. Saunders; 2001, 77-82.
14. Modi A, Kiroukas R, Scott JB. Accuracy of Smartphone Pulse Oximeters in Patients Visiting an Outpatient Pulmonary Function Lab for a 6-Minute Walk Test. *Respiratory Care* 2019;64(Suppl 10):3238714.
15. Disease Control Division, Directorate General of Health Services, Ministry of Health & Family Welfare, Government of the People's Republic of Bangladesh. National Guidelines on Clinical Management of Coronavirus Disease 2019 (COVID-19). In. Dhaka; 2020, 64.
16. Star Online Report. Coronavirus: Govt declares entire Bangladesh at risk The Daily Star 16 April 2020, 2020.
17. Zhan WQ, Li MD, Xu M, Lu YB. Successful treatment of COVID-19 using extracorporeal membrane supplemental oxygenation, a case report. *European review for medical and pharmacological sciences* 2020;24(6):3385-3389.
18. Zehnder JL. Drugs used in disorders of coagulation. In: Katzung BG, ed. *Basic and clinical pharmacology*. 14th ed; 2018, p 608-625.
19. Wilkerson RG, Adler JD, Shah NG, Brown R. Silent hypoxia: A harbinger

- of clinical deterioration in patients with COVID-19. *Am J Emerg Med* 2020; S0735-6757(20)30390-9.
20. MedicineNet. What Causes Death in COVID-19 Coronavirus Patients? <https://www.medicinenet.com/script/main/art.asp?articlekey=229089>.
 21. Parker BM, Hart VJ, Rattan R. Coagulopathy in covid-19: review and recommendations. https://www.facs.org/-/media/files/covid19/umiami_study_uses_of_coagulopathy.ashx.
 22. Llitjos JF, Leclerc M, Chochois C, Monsallier JM, Ramakers M, Auvray M, Merouani K. High incidence of venous thromboembolic events in anticoagulated severe COVID-19 patients. *Journal of thrombosis and haemostasis : JTH* 2020.
 23. Spyropoulos AC, Ageno W, Barnathan ES. Hospital-based use of thromboprophylaxis in patients with COVID-19. *Lancet (London, England)* 2020;395(10234):e75.
 24. Connors JM, Levy JH. COVID-19 and its implications for thrombosis and anticoagulation. *Blood* 2020;135(23):2033-2040.
 25. GrepMed. Mount Sinai COVID-19 Anticoagulation Algorithm. <https://www.grepmed.com/images/7632/anticoagulation-coronavirus-management-algorithm-sarscov2-covid19>.
 26. Atallah B, Mallah SI, AlMahmeed W. Anticoagulation in COVID-19. *European Heart Journal - Cardiovascular Pharmacotherapy* 2020:1-2.
 27. Trank C, Power T, Danehy S, Widger A, Crowe R. Findings Released from NAXOS, a French Real-World Data Analysis and the Largest Real-World Data Analysis on Oral Anticoagulant Effectiveness and Safety in Europe Among Patients with Non-Valvular Atrial Fibrillation In. PRINCETON, N.J., and NEW YORK, N.Y.: Bristol-Myers Squibb-Pfizer Alliance 2019.
 28. Testa S, Prandoni P, Paoletti O, Morandini R, Tala M, Dellanoce C, Giorgi-Pierfranceschi M, Betti M, Battista Danzi G, Pan A, Palareti G. Direct oral anticoagulant plasma levels' striking increase in severe COVID-19 respiratory syndrome patients treated with antiviral agents: The Cremona experience. *Journal of thrombosis and haemostasis : JTH* 2020;18(6):1320-1323.
 29. The European Society of Cardiology. ESC guidance for the diagnosis and management of CV disease during the COVID-19 pandemic. <https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance,2020>.
 30. Brooke J, Jackson D. Older people and COVID-19: Isolation, risk and ageism. *Journal of clinical nursing* 2020;29(13-14):2044-2046.