Clinics in Oncology

Research Article
Published: 20 Feb, 2021

COVID-19: Across-Sectional Study of Practice in the UK and Challenges during the Pandemic

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Abstract

COVID-19 (Coronavirus Disease 2019) is an acute lethal respiratory infection now known as SARS-CoV-2 replacing its previous nomenclature as 2019-nCoV and has spread throughout the world causing the pandemic. The responsibility of countering a pandemic rest with the respective governments with their public health strategies. We present a survey conducted in the UK (United Kingdom) from healthcare staff during the peak of the pandemic. Overall, the responses were positive. But there is a scope for improvement which has been expressed in the survey in terms of better preparedness. The learning should focus on the principles of recognizing the problem, establishing the diagnostic capacity of producing test kits as quickly as possible, early implementation of lockdowns to prevent community transmission robustly, designing and allocate the resources effectively to the new challenge during crisis times. A good idea would also to stockpile PPE's for the future. The use of new technologies like data analysis software, artificial intelligence and integrated cloud platforms for effective public health delivery might prove effective in the future.

Introduction

COVID-19 (Coronavirus Disease 2019) is an acute lethal respiratory infection now known as SARS-CoV-2 replacing its previous nomenclature as 2019-nCoV. COVID-19 has had a profound impact throughout the world in terms of its virulence, morbidity and mortality [1]. Since COVID-19 was first identified on December 30th, 2019 in Wuhan, China through a cluster of pneumonia cases. The disease has spread worldwide and stands at, as of June 12th, 2020, 7481,063 cases of COVID-19 including 421,190 deaths [2,3]. The prevalence for the world is shown in Figure 1 and the EU and the UK in Figure 2 respectively.

A total of 1460,676 and 291,409 cases have been reported in the EU/EEA and the United Kingdom respectively and the deaths recorded as 170,603 and 41,279 deaths in the EU/EEA and the UK as of June 12th, 2020 [3] (Image 1 and 2).

Coronaviruses (CoVs) are viruses covered by the RNA genome, which belong to the *Coronaviridae* family of the subfamily *Coronavirinae* and *Nidovirales* order [4]. Largely, CoVs have been known for their relevance in the radar of the veterinary field for their respiratory and gastrointestinal diseases in mammals and avian species. However, these observations were squashed by the outbreaks of evidence of the viruses bridging animal-Human host defenses causing sporadic outbreaks in the world like Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) with a mortality of 11% and 35% respectively [5,6]. The animal host, places of origin are shown in the figure below in Table 1.

COVID-19 is the latest in the recent Zoonotic diseases caused by SARS-CoV-2 virus. The structure is as shown depicted in Image 3 below. The virus is spherical in shape with spikes emerging from its surface and these spikes are a protein which attaches itself to the surface of the human cells and undergoes a tectonic change leading to the amalgamation of the protein to the human cell membrane. Once the virus fuses with the human cell, the virus replicates in the cell with more copies and multiplies. A combined study by colleagues of Dr Jason McLellan's lab at the University of Texas at Austin and the NIAID Vaccine Research Center (VRC) by Wrapp et al. [9] used cryo-electron microscopy to take a detailed picture of the spike proteins using biophysical assays and showed, that SARS-CoV-2 spike protein is 10 times more potent in binding more tightly than the spike protein of Severe Acute Respiratory Syndrome (SARS)-CoV to the receptors on the human cell surface called Angiotensin-Converting Enzyme 2 (ACE2) thus proving SARS-CoV-2 virus is more potent in its virulence spreading worldwide. The spike protein structure along with its receptor-binding domain

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Received Date: *23 Jan 2021*
Accepted Date*: 16 Feb 2021*
Published Date*: 20 Feb 2021*

Citation:
Khalid MS, Kannappa LK, Athar S, Ibrahim R, Abounozha S, Tawfiq O, et al. COVID-19: Across-Sectional Study of Practice in the UK and Challenges during the Pandemic. Clin Oncol. 2021; 6: 1774.

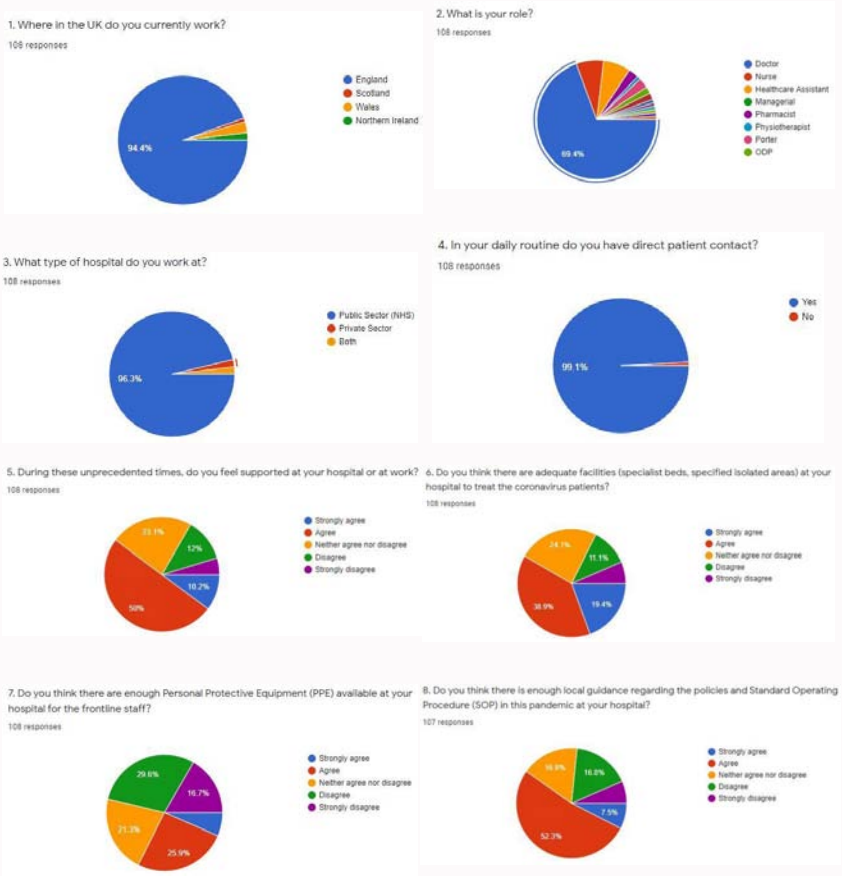

Figure 1: Questionnaire's 1-8.

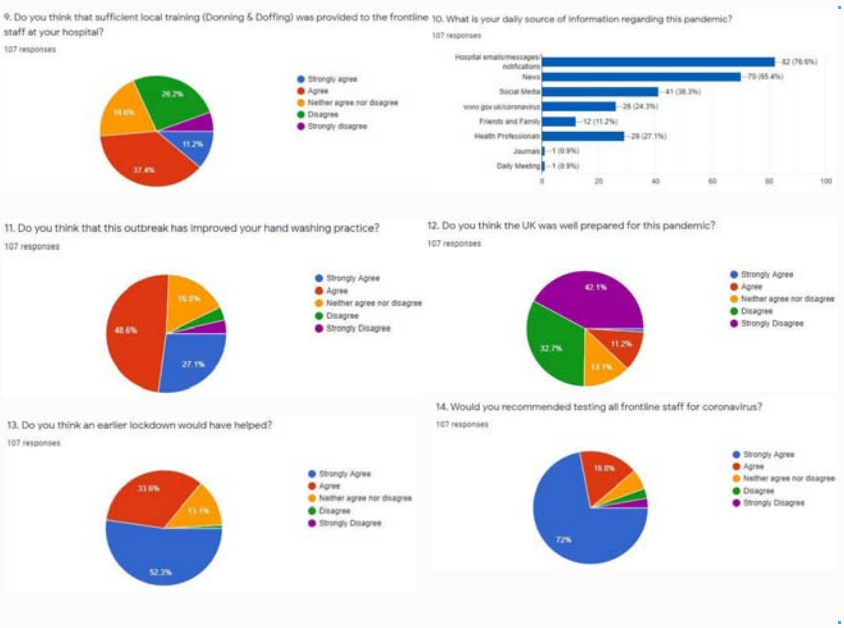

Figure 2: Questionnaire's 9-14.

the part of the spike which attaches to the human cell is shown in the Image 4 below.

The SARS-CoV-2 genome sequence was released in the public domain by scientists in China for the research fraternity for the future development of vaccine and developing treatment strategies. Since the genome release, and subsequent encoding of the spike protein shown above (Image 4) and its similarities with SARS-CoV spike protein. The three different antibodies for the SARS-CoV were not successful against SARS-CoV-2 spike protein suggesting the

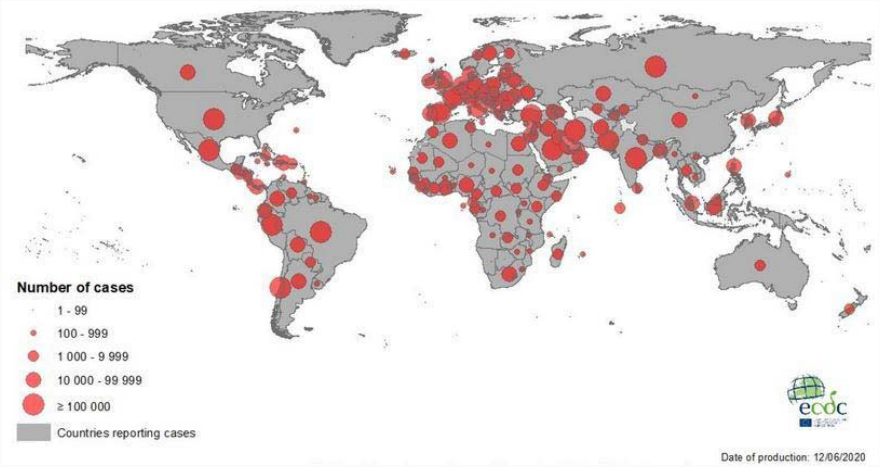

Image 1: Adapted from (https://www.ecdc.europa.eu) [3].

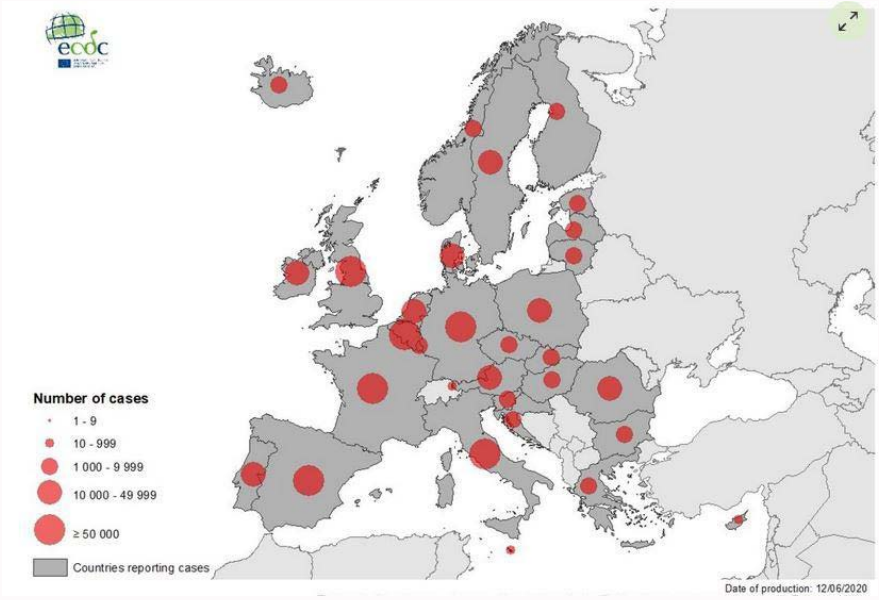

Image 2: Adapted from (https://www.ecdc.europa.eu) [3].

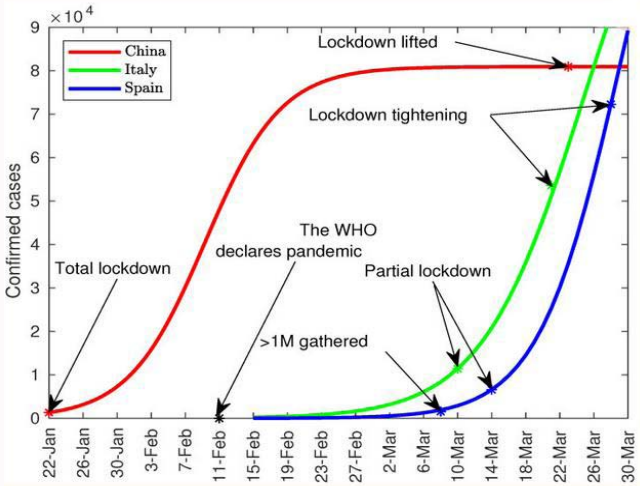

Figure 3: Adapted from Sanchez-Caballero et al. [25].

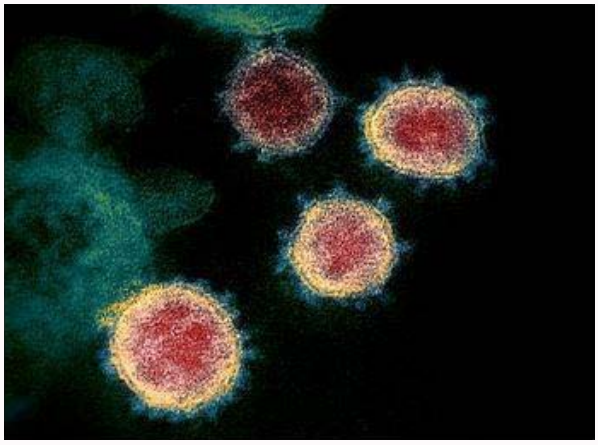

Image 3: (Adapted from https://www.nih.gov). Transmission from Electron microscope image of SARS-CoV-2 showing the virus with spikes around its periphery emerging from the surface of the cells culture in the lab [10].

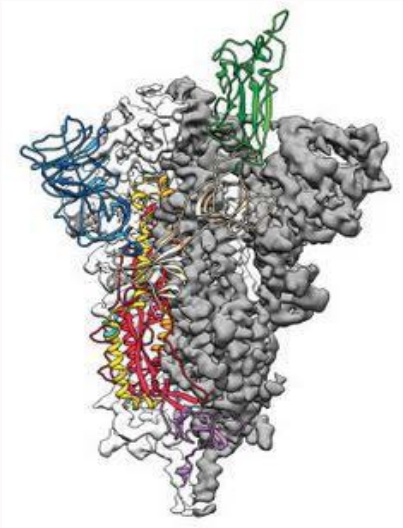

Image 4: Adapted from Wrapp et al. [9] showing the structure of the SARS-CoV-2 spike protein along with its Receptor-Binding Domain (RBD), colored green, which is the binding part of the spike on the host cell surface.

vaccine development and the treatment protocols for a structured protocol will pose a unique challenge to the research community [10]. The emergence of the virus from the wet animal Huanan Sea food Wholesale market in Wuhan, China has made the scientific community suspect about the possible transmission of the virus from the animals sold in the market [2,7].

Studies by Paraskevis et al. [8] on the genetic sequence showed the similarity of the SARS-COv2 and the BatCoV RaTG13 in bats was found to at 96.3% and probably the origin from the bats is more likely. On the other hand, Zhang et al. [11] studies of genetic and evolutionary evidence showed that SARS-CoV-2 virus similarities isolated from dead Malayan pangolins Pangolin - Coronavirus (Pangolin-CoV). The study also showed the Pangolin-CoV is 91.02% and 90.55% identical to SARS-CoV-2 and BatCoV RaTG13 at a genetic level. Even though there are structural similarities in regards to the amino acids between Pangolin-CoV and SARS-CoV-2, amino acid mutations are found in BatCoV RaTG13 and inferred that the pangolin species are a natural reservoir of SARS-CoV-2-like CoVs [11].

Epidemiology and pathogenesis

The robust spread of COVID-19 throughout the world, since its discovery in the Hubei province in China in late 2019 has exposed its pandemic potential. The first case was reported to WHO (World Health Organization) by Chinese officials on December 31st, 2019 as a patient suffering from pneumonia in Wuhan City, Hubei Province, China and a vast majority of cases to the world has come with travel coming out of China [12] (Table 2). Cia et al. study contacted a trace who was tested positive after arriving from Wuhan to Wenzhou in China and the shopping mall the trace went in Wenzhou showed that the cluster of cases which became positive later showed the possible transmission from virus contamination of common objects, virus aerosolization in a confined space or its spread from asymptomatic infected persons [13]. Chan et al. [5] study on a family cluster, who returned to Shenzhen, Guangdong Province, China after a visit to Wuhan showed with pneumonia presented their findings of fever, upper or lower respiratory tract symptoms, or diarrhea, or a combination of these 3 to 6 days after exposure and showed the

Table 1: Zoonotic viruses outbreak worldwide with the country of origin, year and animal host.

Coronavirus (CoV)	Place of Origin	Year	Origin
COVID-19 (SARS-CoV-2)	Wuhan, China	Dec-19	Bats, Pangolin (IH) [7,8]
SARS-CoV*	Guangdong province, China	Nov-02	Bats, Palmcivets [1]
MERS-CoV*	Saudi Arabia	Sep-12	Camels[6]

IH: Intermediate host
*Severe acute respiratory syndrome Coronavirus
*Middle East respiratory syndrome Coronavirus

older patients more than 60 years had more systemic symptoms, extensive radiological ground-glass lung changes, lymphopenia, thrombocytopenia, and increased C-reactive protein and lactate dehydrogenase levels. Even though COVID-19 presents with respiratory disease, it also affects other systems in the body. Baj et al extensive review of clinical manifestations of COVID-19 emphasized that it affects other systems like gastrointestinal system (vomiting, diarrhea, anorexia, or loss of appetite, tenesmus, dysgeusia, gastrointestinal bleeding and hematochezia [14-17]. Neurological (encephalitis, necrotizing hemorrhagic encephalopathy, strokes, epileptic seizures, or rhabdomyolysis) [18], Olfactory and gustatory functions (hyposmia or anosmia) [19,20]. Ophthalmic symptoms (conjunctivitis, conjunctival hyperemia, chemosis, epiphora, or increased secretions) [21], Dermatological (maculopapular exanthem, papulovesicular rash, urticaria, livedo reticularis lesions, or petechia) [22] and cardiovascular symptoms (atrial fibrillation, acute pericarditis, left ventricular dysfunctions, heart failure, cardiogenic shock, blood pressure abnormalities, or myocarditis) [23,24].

As per the centre for disease control and prevention [12], the above guidelines were issues for the hospitals to follow. Our questionnaire was based on these principles and how the UK as a country acted during the COVID-19 crisis through the eyes of the frontline workers during the crisis. This article is based on a short survey carried out by our team on the general opinion of health care workers relevant to the current COVID-19 pandemic, in a collaborative effort to highlight the way health care workers are affected and what might have made a difference in combating the pandemic in the UK. We did consider the gov.uk website. But, cdc.gov gave a global perspective while framing questions.

Material and Methods

A set of 14 questions were formulated regarding COVID-19 practice in the UK. The Questionnaire was sent to all healthcare professionals working in NHS through their emails and the responses were captured between 27/04/2020 till 26/05/2020 through an email interfaced with automated data collection in Google forms survey tool. The Questionnaire included data on the place in the UK, Type of healthcare professional (doctors, nurses, health care assistant, pharmacists etc.) and practice constraints like availability of specialist ward and beds for COVID-19, PPE's (Personal Protective Equipment), SOP's, Training for staff, Daily source of information about COVID-19.

Results

A total of fully completed 107 responses were registered in (https://docs.google.com/forms) (interfaced questionnaire forms) containing 14 questions in total sent by email. The summary of the responses is shown as graphical representations in Figure 1 (Questions 1-8) & Figure 2 (Questions 9-14) below. Questions 1-7 had 108 responses and questions 8-14 had 107 responses.

Table 2: Steps healthcare facilities can take now to prepare for COVID-19. Adapted from [12] Center for Disease Control (CDC).

Be prepared:	
1	Stay informed about the local COVID-19 situation. Know where to turn for reliable, up-to-date information in your local community. Monitor the CDC COVID-19 website and your state and local health department websites for the latest information.
2	Develop, or review, your facility's emergency plan. A COVID-19 outbreak in your community could lead to staff absenteeism. Prepare alternative staffing plans to ensure as many of your facility's staff are available as possible.
3	Establish relationships with key healthcare and public health partners in your community. Make sure you know about healthcare and public health emergency planning and response activities in your community. Learn about plans to manage patients, accept transfers, and share supplies. Review any memoranda of understanding (MOUs) with affiliates, your healthcare coalition, and other partners to provide support or assistance during emergencies.
4	Create an emergency contact list. Develop and continuously update emergency contact lists for key partners and ensure the lists are accessible in key locations in your facility. For example, know how to reach your local or state health department in an emergency.
Communicate with staff and patients:	
1	Communicate about COVID-19 with your staff. Share information about what is currently known about COVID-19, the potential for surge, and your facility's preparedness plans.
2	Communicate about COVID-19 with your patients. Provide updates about changes to your policies regarding appointments, providing non-urgent patient care by telephone, and visitors. Consider using your facility's website or social media pages to share updates.
Protect your workforce:	
1	Screen patients and visitors for fever, respiratory symptoms, or other symptoms before entering your healthcare facility. Keep up to date on the recommendations for preventing the spread of COVID-19 on CDC's website.
2	Ensure proper use of personal protection equipment (PPE). Healthcare personnel who come in close contact with confirmed or possible patients with COVID-19 should wear the appropriate personal protective equipment.
3	Conduct an inventory of available PPE. Consider conducting an inventory of available PPE supplies. Explore strategies to optimize PPE supplies.
4	Encourage sick employees to stay home. Personnel who develop fever, respiratory symptoms, or other symptoms should be instructed not to report to work. Ensure that your sick leave policies are flexible and consistent with public health guidance and that employees are aware of these policies.
Protect your patients:	
1	Stay up-to-date on the best ways to manage patients with COVID-19.
2	Separate patients with fever, respiratory symptoms, or other symptoms so they are not waiting among other patients seeking care. Identify a separate, well-ventilated space that allows waiting patients and visitors to be separated.
3	Consider the strategies to prevent patients who can be cared for at home from coming to your facility potentially exposing themselves or others to germs, like:
4	Using your telephone system to deliver messages to incoming callers about when to seek medical care at your facility, when to seek emergency care, and where to go for information about caring for a person with COVID at home.
5	Adjusting your hours of operation to include telephone triage and follow-up of patients during a community outbreak.
6	Leveraging telemedicine technologies and self-assessment tools.

We received a total of 107 completed questionnaires. A majority of the responses 94.4% (102/108) of the received were from England and a small fraction from Scotland, Ireland and Wales (Questionnaire 1). Among the responses, most of the participants were doctors (69.4%), 14.8% were nurses and health care assistants while managers, pharmacists, physiotherapists, porters and ODPs made up the remaining 15.8% in small fractions (Questionnaire 2). A vast majority (96.3%) were workers in the public sector (NHS) and the rest from the private sector (Questionnaire 3). Majority of the respondents (99.1%) reported having direct contact with patients in their day to day activities at work (Questionnaire 4).

Protecting your workforce

Regarding the support received during the peak of COVID-19 in the hospitals in the UK. Majority of the respondents were on the positive side and were 50% and 10.2% for the "agreed" and "strongly agreed" groups respectively. On the other hand, 16.6% of the respondents responded unfavorably and 23.1% were equivocal (Questionnaire 5). During the peak of the crisis, there was a dearth of PPE (Personal Protective Equipment) available throughout the world. The questionnaire regarding the availability of enough PPE for staff showed the response favorably and not in agreement were 32.8% and 46.3% respectively with neutral being 21.3% (Questionnaire 7).

Protecting patients

We framed questions regarding the adequacy of the facilities in terms of availability of specialist beds specifically for COVID-9 patients in isolated wards at your hospital to treat the coronavirus patients. An overwhelming response of 58.3% of respondents was in agreement against 17.6% in disagreement and 24.1% were neutral opinion (Questionnaire 6).

Communicate with staff and patients

Questions were asked regarding local guidance and Standard Operating Procedure (SOP) during this pandemic at your hospital. A majoritarian view in agreement stands at 59.6% as against disagreeing at 23.3% and neither agrees nor disagrees at 16.8% (Questionnaire 8). Similarly, questions regarding training to staff regarding Donning & Doffing to frontline staff. Donning referred to putting on work clothes, gears and equipment and doffing is a process of how to remove them after the use about 48.6% of respondents only agreed the staff were given training and 31.8 were not happy that they received training. We have to note that the survey was taken during the peak of COVID-19 in the UK (Questionnaire 9).

Be prepared

We did ask questions regarding the daily source of information during the pandemic. The top 3 sources were a local source of information through emails from the local NHS (National Health Service) trusts at 76.6%, news from media (65.4%) and social media at (38.8%). UK website (www.gov.uk/coronavirus) [13], was in the fourth spot in the list of everyday sources at 24.3%. Since its inception, the UK website for coronavirus has robust protocols now.

The other generic questions relevant to the pandemic, we considered necessary in these unprecedented times were about staff becoming more aware of the hand washing in day-to-day activities at work. An overwhelming majority of 75.7% agreed to be more aware. Questions regarding the UK as a country was prepared for COVID-19 pandemic, about 74.8% of respondents felt we were not prepared for the pandemic and a meagre 12.1% disagreed. There was a generalized consensus that the UK was not well prepared. Questions regarding the UK would have benefitted, if a lockdown was done

earlier also showed most of the respondents agreed at 85.9%. During the time of the survey, availability of testing for staff was not available and the first published document regards to testing was published on May 28th, 2020 in the (www.england.nhs.uk) website [14]. Most of the respondents expressed in favor of testing for all staff and stood at 88.8%.

Discussion

Effective modeling followed by countries in the world to deal with a pandemic like COVID-19 has exposed many lacunas which will have to be filled up as a learning curve for the future. Every country affected by COVID-19 has been overburdened with resource constraints and with no exception, the UK also faced similar pressures and taking into account the ageing population and increased life expectancy posed an increased risk despite improved health care and treatments available for all segments of the population in the UK through the NHS (National Health Service).

The feedback from a small sample will not fully reflect the mood of the whole of the staff working in NHS, but gives a snapshot of the inadequacies observed and we need to take cognizant of the opinions and try to reflect and give serious thought about the scope of improvement in the future.

Emanuel et al. [16] study highlighted the pandemic influenza plan in 2017 from the department of health and human services in Washington DC and emphasized the consensus that the emerging pandemics "can place extraordinary and sustained demands on public health and health systems and providers of essential community services" and this will lead to rationing of medical resources like equipment's and interventions [15,16]. The burden of COVID-19 on healthcare systems around the world created a dearth of medical resources leading to rationing like the non-availability of N95 masks in USA (United States of America) lead to fortuity plans of re-using masks meant for single use [17], Italy ordaining the intensive care beds and ventilators for patients who can benefit most like a war contingency [18,19] and the hospital bed shortages in South Korea for COVID-19 patients leading to the death of some patients awaiting admissions to the hospital [20]. The public health England issued guidance on 17/04/020 in alignment with CDC and World Health Organization (WHO) for optimizing the supply of Personal Protective Equipment (PPE) and the use of PPE when in short supply the even though PPE in NHS is designed by manufacturers for single-use [21-23], some compromise in terms of re-use of PPE be needed to accept due to the extreme shortages until the supply chain in place. This led to widespread indignation among the healthcare staff in the UK.

In regards the ethics, logistics and therapeutics on the front-line workers during the pandemic crisis, there were instances where healthcare staff have been denied testing due to scarcity of enough test kits available to asymptomatic staff and was advised to stay home only to be tested positive. They were instances when they were told to quarantine and developed symptoms. They were found quarantining in a basement of his house away from his family and were tested positive weeks later in Italy [24]. There are recognized empathy and also moral obligations as to how the frontline staff had to endure during the crisis with sacrifices in their personal and professional life. During the pandemic, the quote "You have no predictive bible to help you," summarizes the stress and the burden staff has to face when there was a scarcity of the ITU (Intensive Care Unit) beds and ventilators [24].

The predictive models of the approach of the lockdown have had different approaches in countries around the world. There has been no accurate prediction whatsoever at the beginning of the crisis. There have been contemplations regarding partial or full lockdown before and during the crisis. A study by Sanchez-Caballero et al. [25] prediction model with cases from China, Italy and Spain compared between the effects of partial *vs.* complete lockdown and validated the complete lockdown as the standard way of containing the COVID-19 crisis as shown in Figure 3 below [25].

The above figure shows the timeline of the events and the rise in the number of cases when the partial lockdown was exercised in Italy and Spain. Special mention has to be done on the Swedish model, which completely disregarded the lockdown to achieve herd immunity and has been deemed a complete failure with reported higher mortality due to COVID-19 in relative comparison to the neighboring Scandinavian countries who adapted stricter measures [26,27]. The survey highlighted the importance of an early lockdown from the majority of the respondents and would have made the difference.

The COVID-19 crisis has shown the weakness that even a robust healthcare system like the UK also suffered due to overburdened resources with severe economic costs during a pandemic crisis. Ashwin et al. compared Italy *vs.* South Korea's federal government's COVID-19 pandemic responses and argued that South Korea did better because of its creative strategy in identifying new cases and prevent spread with a decrease in incidence rates. Immediately after the first case was noticed, in addition to the cancellation of social events, restricted access to public transportation, and closure of school activities. The creative measures like drive-through COVID-19 testing centers tested more than 250,000 individuals with a testing time of only 10 min and results sent to the patient the next day and automatic update of cases in a government's phone application. Italy followed a traditional approach of complete lockdown with sick patients coming to hospitals resulting in overburdening of the resources [28]. According to a survey in South Korea, Since the MERS-CoV epidemic in 2015, South Korea had hard lessons learnt and increased awareness in terms of social distancing 41.9% to 58.2% (MERS-CoV) to 83.4% to 92.3% (COVID-19), practicing transmission-reducing behaviors (wearing face masks and hand washing) COVID-19 (78.8%, 80.2%) *vs.* MERS-CoV (15.5%, 60.3%) and also paved the way for the innovative drive-through centre for testing [29]. After the population sensitization of the MERS-CoV, The key strategies adopted were (1) recognize the problem, (2) establish diagnostic capacity, (3) implement aggressive measures to prevent community transmission, (4) redesign and reallocate clinical resources for the new environment, and (5) work to limit economic impact through and while prioritizing controlling the spread and impact of COVID-19 [30]. We in the UK probably should encompass the experiences in the other countries in our learning curve dealing pandemics. As per the kingsfund.org.uk publication [31], the total number of beds in NHS including acute, mental illness, learning disability, maternity and day-only beds has decreased from around 299,000 in 1987/88 to 141,000 in 2018/19. The number of acute care and general hospital beds has decreased by 34% since 1987/88 and the new trends like day case surgery and the bulk have been for the care of older people in the UK. The trends are universal all around the world including the UK. These trends reflect a challenging time for fighting a pandemic effectively. As of today, 09/07/2020, UK is in third place with around 44,602 deaths behind USA (United States of America)

and Brazil. UK has done well in terms of the testing the population 166,244 per million as against 119,326 per million in USA and 21,021 per million in Brazil. The deaths per million for the UK was around 657, Italy - 577, USA - 408, Spain - 607 and Germany - 109 [32]. The trends show that even though, the UK as a country is testing far high in comparison to other countries. It has reported more deaths. This poses a question on the response and the public health measures undertaken were not adequate. There are some creative suggestions in the literature worth mentioning like Taiwan's strategy post-2003 severe acute respiratory syndrome outbreak. They used data analytics platforms, combining artificial intelligence and cloud technology; public health policymaking could be practicable. Post-2003 outbreak Taiwan transferred real-time infectious data with monitoring systems where PPE stockpiling platform was practiced [33].

Conclusion

The pandemic crisis has indeed shown that like many countries there seems to be a delay in recognition and understanding of the pandemic reflected by the high mortality in the UK. The learning curve of other countries gives us ample knowledge and should focus on the principles of recognizing the problem, establishing the diagnostic capacity of producing test kits as quickly as possible, early implementation of lockdowns to prevent community transmission robustly, designing and allocate the resources effectively to the new challenge during crisis times. A good idea would also to stockpile PPE's for the future. The use of new technologies like data analysis software, artificial intelligence and integrated cloud platforms for effective public health delivery might prove effective in the future.

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