Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

International Journal of Infectious Diseases 103 (2021) 182–187

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

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

A novel use of telemedicine during the COVID-19 pandemic

Mary Rose Cassar[a], Denise Borg[b,*], Lianne Camilleri[c], Aaron Schembri[d], Eloise Agius Anastasi[a], Kenneth Buhagiar[a], Claire Callus[e], Michelle Grech[e]

[a] Department of Accident and Emergency Medicine, Mater Dei Hospital, Msida, Malta
[b] Department of Infectious Diseases, Mater Dei Hospital, Msida, Malta
[c] Department of Diabetes and Endocrinology, Mater Dei Hospital, Msida, Malta
[d] Department of General Medicine, Mater Dei Hospital, Msida, Malta
[e] Department of Geriatrics, Mater Dei Hospital, Msida, Malta

ARTICLE INFO

Article history:
Received 8 July 2020
Received in revised form 16 November 2020
Accepted 17 November 2020

Keywords:
COVID-19
Pandemic
Telemedicine
Emergency department
Outpatients

ABSTRACT

Objective: The coronavirus disease-2019 (COVID-19) global pandemic brought with it many challenges but possibly the biggest was the best use of national hospital resources. With the aim to protect the hospital healthcare resources in the country whilst simultaneously safeguarding the health of COVID-19-infected patients, a telemedicine system led by experts was set up in Malta.
Methods: A team of local experts, called the 'Community COVID-19 Initial Assessment team' (CCIAT), co-ordinated the initial medical assessment and decisions for all newly diagnosed community patients. Data of all patients were collected prospectively and stored in one database. These data were then analysed to extract the demographics and outcomes of all these patients.
Results: Through telemedicine, the majority (91%) of 369 infected patients were managed safely in the community. Only a minority of patients (6%) was admitted to the main acute hospitals and there was no increased morbidity or mortality related to the medical decisions made using this telemedicine tool.
Conclusions: This population-based study proves that this particular COVID-19 telemedicine project in Malta achieved its main goals, which were namely that of relieving the burden on the main local acute hospitals whilst ensuring the optimal medical management to infected patients.

Introduction

Malta is an archipelago situated in the middle of the Mediterranean Sea with a population of circa 493,559 people (National Statistics Office, 2018). It provides a free National Health System (NHS) with two main government hospitals, situated on each of the two main islands: Mater Dei Hospital (MDH), located in Malta and Gozo General Hospital (GGH), found on the sister island, Gozo. Both these hospitals house the main emergency departments (ED) for the respective islands. One also finds a state-run primary healthcare system composed of a number of regional health centres. (health.gov.mt, 2019). MDH is, however, the main tertiary hospital in the country.

The Maltese health authorities started monitoring the coronavirus disease-2019 (COVID-19) situation early on in its course when it was still mostly but not limited to China. However, when the virus reached Europe, specifically Italy, a neighbouring country, the Maltese health authorities brought together a team of experts to assess the population risks, to organise surveillance, diagnosis and containment as well as mitigation processes to ensure that all available national health resources were used in the most efficient and effective way (World Health Organization, 2020a). In this regard, a working group made up of MDH Infectious Disease (ID) Specialists, Emergency Physicians and executive hospital administration in collaboration with public health specialists and primary care specialists was set up. This led to the development of a team called 'Community COVID-19 Initial Assessment team' (CCIAT). The main aim of CCIAT was that of relieving the burden on the main Maltese hospitals by providing a system whereby patients with confirmed COVID-19 were contacted and triaged early on, through telephone consultation and referred appropriately for optimal medical management of the individual patients. A secondary, but highly significant aim was to ensure the provision of early medical guidance and advice to patients as well as to provide reassurance

* Corresponding author.
E-mail addresses: mary-rose.cassar@gov.mt (M.R. Cassar), denise.formosa@gov.mt (D. Borg), lianne.camilleri@gov.mt (L. Camilleri), aaron.schembri@gov.mt (A. Schembri), eloise.caruana@gov.mt (E.A. Anastasi), kenneth.buhagiar@gov.mt (K. Buhagiar), claire-ann.cassar@gov.mt (C. Callus), michelle.a.grech@gov.mt (M. Grech).

https://doi.org/10.1016/j.ijid.2020.11.170

and social support where needed. The latter was deemed crucial for the sustainability of public health quarantine and disease containment protocols, whilst ensuring a smooth running of the national health care system and curtailing unnecessary visits and contamination of the country's main EDs and hospitals (World Health Organization, 2020b, c).

The CCIAT comprised a group of experienced doctors, from different medical backgrounds, including emergency medicine, general medicine and geriatric medicine. The team was guided by an infectious disease specialist. A teleworking system based on telephone communications, emails and a shared online database was set up. This database was established on an online portal platform, which facilitated easy, real-time access and traceability of data. This fully integrated system was made available to CCIAT doctors, all medical doctors working at MDH involved in managing COVID-19 patients as well as public health doctors and a selected group of primary care physicians. These data collected were presented on a patient dashboard. These data linked the patient's demographic details, medical history and advice inputted by CCIAT to specific hospital requirements such as ED assessment and management, oxygen requirements, ventilator need and hospital admissions. This portal was also linked to a COVID-19 information portal and secondary hospitals identified to cater for low-risk patients who required hospitalisation mainly in view of social reasons (World Health Organization, 2020b). Different professionals had access to specific fields, which matched their specific role in this process. All data protection measures were taken to ensure an appropriate level of data confidentiality and safe management of data.

The CCIAT made use of a standardised online questionnaire, formulated to enable a telephone risk stratification of the individual COVID-19-positive patient. Data inputted in this online system included general demographic details, previous health status and comorbidities, a thorough drug history, the date of symptom onset and symptomatology, including severity and the presence of red flag symptoms (Cohen and Blau, 2020). The demographic data, medical history and symptoms of the patient's household contacts were also recorded, to ensure and safeguard the health of all persons living in the same household (World Health Organization, 2020b). This information enabled CCIAT members to identify and advise household contacts who would benefit from contact testing. This information was also necessary to alert public health authorities when patients were deemed unreliable to comply with self-isolation or unable to follow mandatory quarantine regulations. Public health specialists worked in tandem with CCIAT and were directly responsible for contact tracing as well as ensuring that all positive patients who remained in the community observed the mandatory quarantine imposed. Besides working closely with the national contact tracing team, the CCIAT also worked closely with the national laboratory, which was processing all the swabs taken in the country during the time of this study. All swabs were tested by the RT-PCR method. The criteria for swab testing at the time of the study included symptomatic patients with history of contact with known positive patients or with a history of travel abroad or asymptomatic close contacts of known COVID-positive patients or patients undergoing a preoperative assessment in hospital. Although all hospital admissions were swabbed, these admissions were managed by the hospital teams and not by the CCIAT because they were already receiving medical care. These criteria changed to widespread swabbing of any suspicious symptoms, any suspicious contacts, any travel and wider contact tracing during the second wave that followed the period of this study. The CCIAT continued to work and is still functioning albeit busier at the time of the submission of this article.

A specific care-pathway (Figure 1) provided the professionals with a stepwise guidance in this telemedicine process. All individual cases were discussed with the team leader, who in turn consulted the hospital's ID team. The final decision regarding admission was taken by the ID team. Subsequently, following the initial telephone consultation, every patient managed in the community was followed up through telephone by the primary care physicians for a further 14 days. Their data were inputted on the portal database and could be accessed by all stakeholders.

Methodology

This study is a population-based study as MDH serves the whole of Malta and the cohort consisted of all the patients who were assessed by CCIAT in the period between 25 March 2020 (first day of this service) and 24 May 2020, a two-month period, including the peak of the disease in Malta (health.gov.mt, 2020). To ascertain whether this innovative telemedicine service achieved its primary goal; the optimal and appropriate use of the main EDs and hospitals in the country, data collected by the CCIAT were analysed. We specifically examined the patients' demographics, health status, the presence of significant comorbidities, number of symptomatic patients and severity of symptoms (see Table 1) (Cohen and Blau, 2020) and the number of patients requiring hospitalisation.

We also analysed whether any of the patients managed in the community deteriorated clinically and whether they required unforeseen ED attendance or admission. This data analysis enabled us to obtain an overview of the patients' general well-being and to prove the safety and efficacy of the system. All the patients assessed by CCIAT were followed up for two weeks after initial assessment. This ensured that any unforeseen untoward outcomes of these telephone consultations were identified. Statistical analyses were performed using Microsoft Excel® for MAC 2011.

Patients who were already hospitalised at the time of their COVID-19 diagnosis were excluded from this service as they were already under the care of ID specialists, and therefore did not require CCIAT assessment. Migrants residing at the detention centres were also excluded from this service. The reason for this being the language barrier encountered and the lack of contact devices available for communication. A separate group of onsite physicians dealt with such cases (Inter-Agency Standing Committee, 2020). COVID-19-positive patients below the age of 16 years were also excluded because they were not assessed by CCIAT but by a similar group of doctors, namely paediatricians.

Results

During the study period, 369 COVID-19-positive patients were assessed by CCIAT. Of the patients assessed, 195 were males and the remaining 174 were females. The age ranges for the sexes were almost identical with 18–86 years for males and 17–86 years for females. Interestingly, in Malta, chi-squared analysis of these gender numbers did not show any statistically significant difference. The mean age for male subjects was 38 years, whilst that of female subjects was 34 years. Overall, the median age for the whole population of infected persons in the community was 36 years. Table 2 shows the age distribution; the majority of patients were aged between 20 and 60 years. Twenty-six patients were considered vulnerable persons (7%) in view of their age (age over 65 years).

The association between gender and symptom severity as well as that between age and symptom severity was studied. As shown in Table 3, there were minor gender differences in the mild to moderate symptoms and asymptomatic groups with the commonest presentation being that of mild to moderate symptoms. Severe symptoms were present only in 19 patients, which is a small percentage (5%) of the patients assessed. Even though severe

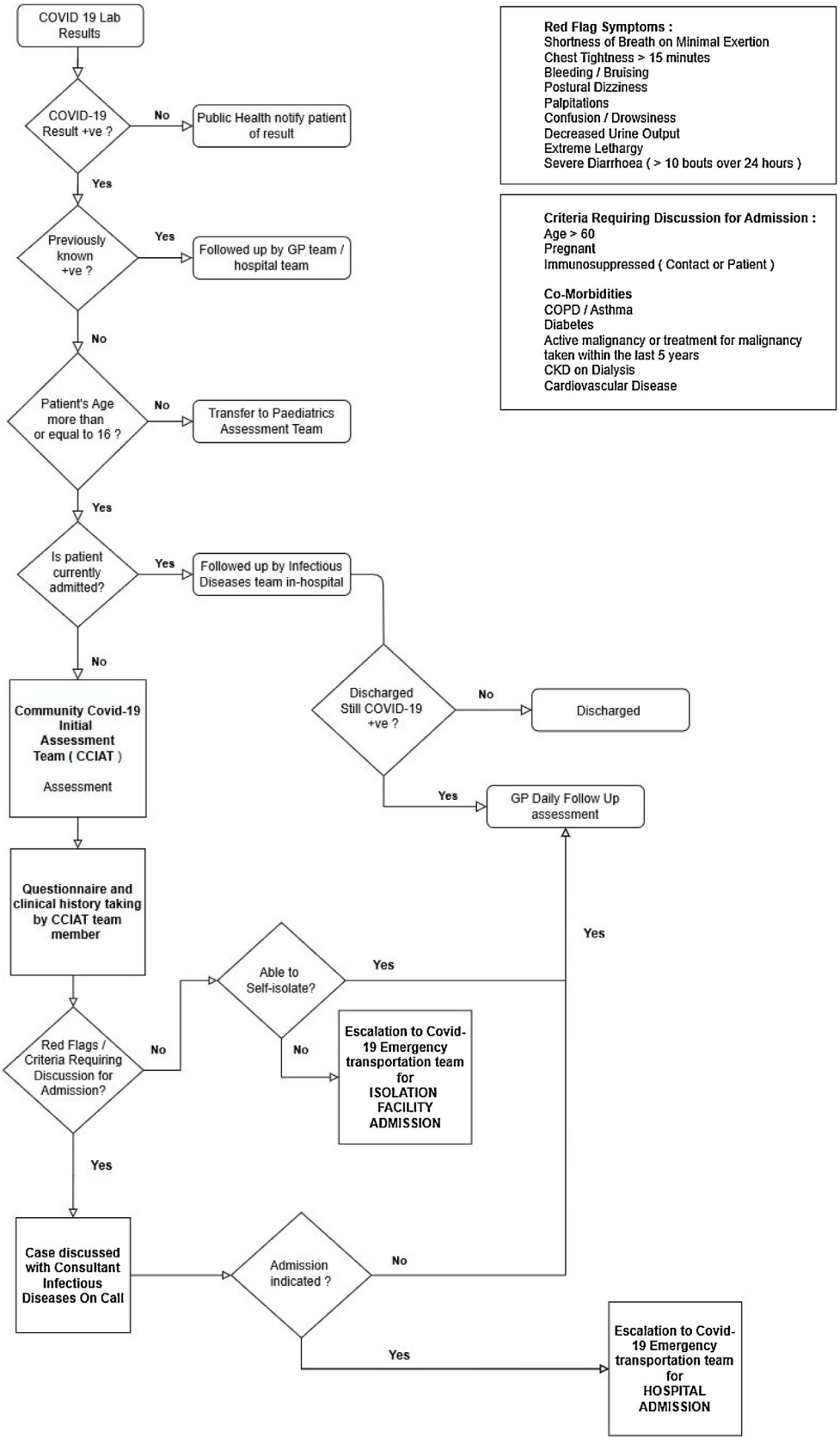

Figure 1. CCIAT care pathway.

Table 1
Classification of symptomatology.

Classic symptoms	Mild/Moderate symptoms	Severe symptoms
Fever	Anorexia	Dyspnoea on minimal exertion
Cough	Malaise	Chest tightness (>15 min)
	Muscle pain	Bleeding/bruising
	Sore throat	Postural dizziness or fainting
	Nasal congestion	Palpitations
	Headache	Confusion/Drowsiness
	Diarrhoea	Extreme lethargy
	Nausea or Vomiting	Decreased urine output
	Anosmia	Severe diarrhoea (>10 episodes in 24 h)
	Ageusia	

Table 2
The number of patients according to age group.

Age ranges/years	Number of patients
16–20	15
21–30	97
31–40	104
41–50	55
51–60	50
61–70	29
71–80	15
81–90	4
>91	0

Table 3
Symptom distribution according to gender at the time of initial assessment.

Gender	Severe symptoms	Mild/Moderate	Asymptomatic
Male	14	132	50
Female	5	124	45

Table 4
Correlation between age, severity of symptoms and gender.

Age range	Severe symptoms		Mild/Moderate symptoms		Asymptomatic	
	Males	Females	Males	Females	Males	Females
16–20	1	0	5	4	0	2
21–30	2	0	25	38	11	12
31–40	1	1	45	31	16	11
41–50	2	1	18	24	9	4
51–60	5	2	18	11	10	9
61–70	1	1	13	10	3	5
71–80	1	0	7	4	1	2
81–90	1	0	1	2	0	0

Table 5
The presence of significant comorbidities in the patient cohort studied.

Comorbidity	Number of patients	% presence in the total cohort of patients
Diabetes mellitus	19	5.1
Chronic respiratory conditions	16	4.3
Chronic cardiovascular conditions	19	5.1
Hypertension	46	12.5
Malignancy	13	3.5
Chronic renal problems	1	0.3
Cerebrovascular disease	4	1.1
Immunosuppression state	3	0.8
Pregnancy	1	0.3
Other chronic conditions	14	3.8
No comorbidities	267	72.9

symptoms occurred more frequently in males (male : female, 3:1), this difference was not statistically significant ($p = 0.17$).

In all age groups, the commonest symptoms present at initial assessment were those defined as mild or moderate symptoms. For all age groups, male patients were more likely to present with severe symptoms when compared to female patients as shown in Table 4.

It was also interesting to note that symptoms such as fever and cough, initially thought to be part of the case definition were only found in 3.9% and 5.8%, respectively in our cohort. Anosmia, another marker of COVID-19 infection and a symptom, which received much attention worldwide, was only present in 2.8% of our patients (Klopfenstein et al., 2020; Hopkins et al., 2020).

Only 95 (25.7%) of the patients assessed had significant comorbidities. Table 5 shows the percentage of patients with and without significant comorbidities and the specific types of comorbidities, when present.

Whilst 72.9% of the patients had no significant comorbidities, 18.4% had a single comorbidity, 4.3% had two comorbidities and 3.6% had 3 or more comorbidities. Symptoms in patients with significant comorbidities and in those without comorbidities were noted to show similar patterns.

More than half of the patients (51.2%) were assessed by the CCIAT on the day of diagnosis while the remaining 48.8% were contacted the day after diagnosis.

Only 18 patients (5%) were referred for ED assessments by the CCIAT and out of these 18 referrals, 15 patients (83% of those referred) were admitted to hospital whilst three patients were assessed and investigated at the ED and subsequently discharged home. Out of these 18 patients, four patients attended the ED for a second time in the span of two weeks (three following a short hospital admission and one who was discharged from the ED on his first attendance). All four patients were discharged home following their second ED attendance. One patient refused referral to the ED only to require admission at a later stage in view of a different complaint.

The CCIAT also referred 30 patients for direct admission to secondary nonacute hospitals. Of these, four patients were admitted for clinical observation as these patients were at an increased risk of deterioration whilst 26 patients were admitted purely as they were unable to self-isolate as per public health guidance. Three patients were admitted through the ED to MDH and GGH for non-COVID-related issues (intrauterine growth restriction, pilonidal abscess and biliary colic).

From the cohort of patients who were managed in the community and not initially admitted to a health care facility only 15 patients (4.5%) attended the ED during the two weeks follow-up period. Eight out of the 15 patients were admitted to hospital but none required intensive care unit (ICU) or high dependency unit (HDU) management. Primary care physicians referred two of these patients following discussions with the CCIAT. No significant morbidity or deaths were recorded in those patients who were kept in the community by the CCIAT

Table 6 summarises the total ED attendances and their subsequent management, whilst Table 7 summarises the reasons for COVID patient hospital admissions.

Discussion

During the study period, a total of 481 new COVID-19 diagnoses were made in Malta (health.gov.mt, 2020) and the CCIAT was responsible for contacting 369 (76.7%) of these patients. Patients

Table 6
Number of patients attending the ED in the two weeks following their diagnosis.

Number of patients referred to the ED by CCIAT		Number of patients not referred to the ED by CCIAT (self-referred)		Number of patients who did not attend the ED
Number of patients admitted to MDH for COVID reasons	Number of patients not admitted to MDH	Number of patients admitted to MDH	Number of patients not admitted to MDH	
15	3	10	5	336

Table 7
Types of hospital admissions of COVID-19 patients.

Number of patients referred by CCIAT to a secondary hospital (not MDH)		Number of patients admitted to MDH by CCIAT		Number of patients admitted to MDH through other routes	Number of patients who were not admitted in the 2-week follow-up
Clinical reasons	Isolation reasons	COVID-related reasons	Non-COVID-related reasons		
4	26	15	3	10	311

who were not contacted included those below 16 years of age, migrants residing at detention centres, and patients already hospitalised when diagnosed. Despite excluding the aforementioned patients, the CCIAT communicated with and assessed the vast majority of adults diagnosed with COVID-19 on the Maltese islands.

Our patient demographics show that the large majority (83%) were aged between 20 and 60 years, with a median age of 36 years. Only 7% were aged over 65 years. This may be attributed to the direct effect of national social restrictions active during the study period. The vulnerable population, including people over 65 years of age and people with significant comorbidities, were strongly advised to stay indoors and avoid social contact. This also explains the absence of comorbidities in a considerable number of patients (73.7%).

Regarding symptomatology in all age groups, the commonest symptoms were those defined as mild or moderate. Once again, this may be attributed to the fact that most patients were young, previously healthy individuals. Similar results were observed in other countries (Cohen and Blau, 2020).

All patients assessed were contacted within 24 h of COVID-19 diagnosis, with the majority being contacted on the same day of diagnosis. The system adopted by CCIAT was efficient and ensured that a medical assessment was carried out early on, thus allowing early referral to hospital prior to the clinical deterioration of COVID-19 patients.

The CCIAT telephone medical consultations resulted in a minority of patients being referred for ED assessment and admission to the main, acute hospitals. The low referral rate did not compromise patient care and decisions taken seem to have been appropriate, as may be suggested by the fact that very few patients were hospitalised when not directly referred by the CCIAT. These findings, together with the knowledge that none of the patients managed in the community required ICU/HDU management or succumbed to COVID-19 infection reflect the effectiveness and safety of the CCIAT. Indeed, these numbers demonstrate that the CCIAT succeeded in achieving its original goal; that of providing a safe and effective approach of relieving the COVID-19 burden on the main Maltese hospitals and also decreasing the potential contamination of hospital and hospital staff.

A literature search in an attempt to compare our telephone triage system did not yield many results. Considering that COVID-19 resulted in a global pandemic, one would expect that such a system would have been discussed and practised. However, during this literature search we came across a well-detailed article recommending outpatient management for COVID-19 patients and detailed measures of how to implement it, including telephone consultations (Cohen and Blau, 2020). Interestingly, the article quotes that in approximately 80% of patients, the illness was mild and did not warrant medical intervention or hospitalisation. This was also observed in our patient cohort.

Another beneficial use of telemedicine, particularly during a pandemic, is that of minimising the movement of infected individuals seeking medical advice. This results in minimal exposure to other community members as well as reducing the risk of contaminating healthcare professionals and unnecessary use of personal protective equipment (Turer et al., 2020), which tend to become scarce in pandemics.

An important role taken on by the CCIAT was that of identifying patients who were well but at risk as defined by ECDC guidelines (European Centre for Disease Prevention and Control, 2020) or were living in households where the isolation of the infected person was not possible. By referring such patients for admission to secondary hospitals, the CCIAT ensured a close medical watch of the highly vulnerable and also ensured that public health containment policies were followed (World Health Organization, 2020b, c).

By providing information regarding access to psychosocial services, the CCIAT was a lifeline for patients who needed psychological and social support (Malta Together, 2020). Reassuring patients that they were going to be closely followed up by a healthcare professional on a daily basis following the initial assessment, helped to keep anxiety related to the diagnosis at bay in most instances. The main role of the CCIAT was not to investigate or manage the psychological or social needs of the patients but whenever a contacted patient admitted to social challenges like living alone, employment issues or unable to procure essential things like food and medicine, they were referred to the appropriate agencies on the island. Similarly, patients who were flagged as being very anxious, depressed and have any psychological issues, were referred to a special helpline which was available 24/7.

Needless to say, although this project generally worked well and achieved its goals, the CCIAT was faced with quite a few challenges. These were mainly communication related issues, such as patients not answering their phones, incorrect telephone numbers and in certain instances, language barriers. Although language barriers can hinder such communications, retrospectively, the vast majority of patients could communicate well in Maltese, English or Italian, languages all well spoken by the CCIAT professionals.

Conclusion

In conclusion, the CCIAT project was innovative to our island and worked well. It achieved its goals of safe risk stratification of

COVID-19 patients, safe management on an outpatient's basis as well as appropriate and efficient use of hospital resources. It also assisted in the containment of the pandemic in our country. Although we do acknowledge that our population is small, such a model can be used for regions in larger countries with a well-defined catchment area and a well-organised healthcare system (Hollander and Carr, 2020). To be sustainable and effective, such telemedicine systems need to be a part of a solid infrastructure healthcare system, led by experts and backed up by protocols (Greenhalgh et al., 2020).

The COVID-19 pandemic has changed the world and has stretched various health care systems to their limits. COVID-19 has been heralded as a novel virus and healthcare systems need to be innovative with regard to how to mitigate its harm. The use of telemedicine during the COVID-19 pandemic has been supported by international bodies such as the WHO (World Health Organization, 2020b, c). From our experience, telemedicine can be safely used to safeguard the health of both infected people and vulnerable people in a given population. It can also initiate the process to address the psychosocial needs of COVID-19 patients by flagging such patients and referring them to the appropriate agencies. Most importantly telemedicine can be used to ensure that healthcare resources are used in the most efficient and effective way during pandemics.

Funding

None declared.

Conflict of interests

None.

Ethical approval

Approval from Ethics Committee obtained.

Acknowledgements

Dr. Charles Mallia Azzopardi.

References

Klopfenstein T, Kadiane-Oussou NJ, Toko L, et al. Features of anosmia in COVID-19 [published online ahead of print, 2020 Apr 17]; S0399-077X(20)30110-30114. Med Mal Infect 2020;, doi:http://dx.doi.org/10.1016/j.medmal.2020.04.006.

Cohen P, Blau J. In: Post T, editor. Coronavirus Disease 2019 (COVID-19): Outpatient Management in Adults. Waltham, MA: UpToDate; 2020. . UpToDate. [Accessed 1 July 2020] www.uptodate.com.

European Centre for Disease Prevention and Control. Information on COVID-19 for Specific Groups: Patients with Chronic Diseases, People with Immunocompromising Condition and Pregnant Women. 2020. . [Accessed 1 July 2020] https://www.ecdc.europa.eu/en/news-events/information-covid-19-specific-groups-patients-chronic-diseases-people.

Greenhalgh T, Koh GCH, Car J. Covid-19: a remote assessment in primary care. BMJ 2020;368:m1182, doi:http://dx.doi.org/10.1136/bmj.m1182.

Health.gov.mt. Services. 2019. . [Accessed 1 July 2020] https://deputyprimeminister.gov.mt/en/Pages/health.aspx.

Health.gov.mt. Covid-19 Infographics. 2020. . [Accessed 1 July 2020] https://deputyprimeminister.gov.mt/en/health-promotion/covid-19/Pages/covid-19-infographics.aspx.

Hollander JE, Carr BG. Virtually perfect? Telemedicine for Covid-19. N Engl J Med 2020;382:1679, doi:http://dx.doi.org/10.1056/NEJMp2003539.

Hopkins C, Surda P, Kumar N. Presentation of new onset anosmia during the COVID-19 pandemic. Rhinology 2020;58(3):295–8, doi:http://dx.doi.org/10.4193/Rhin20.116.

Inter-Agency Standing Committee. Interim Guidance on Scaling-up COVID-19 Outbreak in Readiness and Response Operations in Camps and Camp-like Settings (jointly developed by IFRC, IOM, UNHCR and WHO). 2020. . [Accessed 1 July 2020] https://interagencystandingcommittee.org/other/interim-guidance-scaling-covid-19-outbreak-readiness-and-response-operations-camps-and-camp,2020.

Malta Together. Helplines. 2020. . [Accessed 1 July 2020] https://www.maltatogether.com/helplines.

National Statistics Office. National Statistics Office Malta, Selected Indicators. 2018. . [Accessed 1 July 2020] https://nso.gov.mt/en/nso/Selected_Indicators/Pages/Selected-Indicators.aspx.

Turer RW, Jones I, Rosenbloom ST, Slovis C, Ward MJ. Electronic personal protective equipment: a strategy to protect emergency department providers in the age of COVID-19. J Am Med Inform Assoc 2020;27(6):967–71, doi:http://dx.doi.org/10.1093/jamia/ocaa048.

World Health Organization. Critical Preparedness, Readiness and Response Actions for COVID-19. 2020. . [Accessed 1 July 2020] https://www.who.int/publications/i/item/critical-preparedness-readiness-and-response-actions-for-covid-19.

World Health Organization. Home Care for Patients with Suspected Novel Coronavirus (nCoV) Infection Presenting with Mild Symptoms and Management of Contacts. 2020. . [Accessed 1 July 2020] https://www.who.int/publications-detail/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts.

World Health Organization. Operational Considerations for Case Management of COVID-19 in Health Facility and Community. 2020. . [Accessed 1 July 2020] https://www.who.int/publications/i/item/10665-331492.