



The impact of a virtual cardiology outpatient clinic in the COVID-19 era

Gregory Offiah¹ · Cormac O'Connor¹ · Max Waters¹ · Niall Hickey¹ · Bryan Loo¹ · David Moore¹ · David Mulcahy¹ · Vincent Maher¹

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Abstract

Background Restrictions as a result of the COVID-19 pandemic have demanded an innovative approach to provide appropriate patient review. We have been running virtual cardiology clinics as per Health Service Executive guidance.

Aims Our study aims to determine how virtual clinics change practice vs traditional clinics.

Methods A retrospective cohort analysis was conducted on patients attending cardiology clinics in our hospital from 6 January to 13 March 2020 ('traditional clinic', $n = 1644$), compared with clinics during the COVID-19 outbreak, from 16 March to 22 April 2020 ('virtual clinic', $n = 691$), with the same medical staff.

Results There was no difference in age (61 vs 60), case mix or new vs return appointments in virtual vs traditional clinics. There were similar rates of clinic participation, 71.8% vs 74.2%. A lower proportion of investigations (e.g. imaging) were booked in virtual (38.5%) vs traditional (55.7%) clinics, $p < 0.00001$. Management changes (e.g. medication changes) were less frequent in virtual (19.9%) vs traditional (38.5%) clinics, $p < 0.00001$. However, the discharge rate was higher in virtual (28.8%) vs traditional (19.5%) clinics, $p = 0.00003$.

Conclusion This study highlights that virtual clinic consultations are associated with fewer investigations, fewer management changes, and increased discharge rates compared with traditional consultations. These practice changes would reduce costs and hospital outpatient congestion by avoiding unnecessary hospital reviews. Nonetheless, it is unknown whether patients requiring face-to-face consultations could be missed as a result of this virtual approach. Longitudinal studies are required to assess clinical outcomes as a result of these practice changes and whether patient satisfaction is altered.

Keywords Cardiology clinic · COVID-19 · Telemedicine · Virtual clinic

Introduction

The COVID-19 outbreak and subsequent lockdown restrictions have had a significant effect on healthcare systems. Outpatient follow-up was particularly difficult during this time. Since the middle of March 2020, the general cardiology clinics in our hospital have been run as virtual clinics via telephone consultation. This adaptation to our service was developed to minimise face-to-face contact and the potential spread of coronavirus during the pandemic. These clinics were established according to guidance from the Health Service Executive [1].

During the pandemic, telemedicine has been of growing importance. It has been used to triage patients prior to emergency department attendance, as well as offering remote monitoring for isolated high dependency patients [2]. Telemedicine is a rapidly growing aspect of healthcare worldwide, and new innovations will aid more widespread integration into health services [3]. Irrespective of the sudden need for change to our practice, the question has been long raised as to what effect virtual clinics would have on the efficiency and clinical outcomes of cardiology outpatient clinics. This study aims to determine how virtual consultations change practice compared to traditional face-to-face consultations.

✉ Gregory Offiah
goffiah@tcd.ie

¹ Department of Cardiology, Tallaght University Hospital, Dublin, Ireland

Methods

A retrospective cohort analysis was conducted on patients attending the general cardiology clinics in our hospital before the COVID-19 outbreak (6 January 2020 until 13 March 2020, ‘traditional clinic’) compared with clinics provided during the outbreak (16 March until 22 April 2020, ‘virtual clinic’). Forty-one traditional clinics and 20 virtual clinics took place during the study period. All virtual clinic consultations were carried out via telephone. This study period was chosen to ensure that care was provided by the same consultants and non-consultant hospital doctors. All patients registered to attend cardiology clinic during the study period were included. No patients were excluded from this study. The hospital’s patient administration system was used to determine the number of patients that participated, cancelled, or did not attend/participate (DNA) in their virtual or traditional clinic appointments. Clinic letters were reviewed for all patients that participated in their appointment using the hospital’s electronic patient record. Data on primary indication for appointment, investigations booked, management instituted during appointments, and discharge rates was collected. Standard Bayesian statistics were utilised to conduct the analysis. Chi-square and Student’s *t*-test were used as appropriate. *P* values were 2-tailed, with a value of < 0.05 considered significant.

Results

Clinic characteristics

A total of 2335 clinic interactions were recorded during the study period; 691 in virtual clinics and 1644 in traditional clinics. The proportion of new and return patients was well matched in both groups. Return appointments made up the majority of clinic interactions, with 548 (79.3%) patients in the virtual clinics and 1313 (79.9%) patients in the traditional clinics. The distribution of presenting complaint was equal in both groups (Table 1). Cardiovascular disease was the most common presenting complaint in both groups, with 195 (39.3%) patients in the virtual clinics and 468 (38.4%) patients in the traditional clinics. Cardiovascular risk factor management, arrhythmia and syncope, heart failure, and valvular disease contributed to the majority of the interactions in both clinic groups. When each presenting complaint was sub-categorised (e.g. arrhythmia and syncope was segregated into (1) palpitation/syncope work up, (2) atrial fibrillation, (3) supraventricular tachycardia, (4) ventricular tachycardia, and (5) bradycardia), there was a similar distribution in

Table 1 Clinic characteristics

	Virtual clinic (<i>n</i> = 691)	Traditional clinic (<i>n</i> = 1644)
Appointment type:		
New	143 (20.7%)	331 (20.1%)
Return	548 (79.3%)	1313 (79.9%)
Attendance:		
Participated	496 (71.8%)	1220 (74.2%)
Did not attend/participate	112 (16.2%)	176 (10.7%)
Cancelled	83 (12.0%)	248 (15.1%)
Presenting complaint: (<i>n</i> = 496) (virtual) / (<i>n</i> = 1220) (traditional)		
Cardiovascular disease	195 (39.3%)	468 (38.4%)
Cardiovascular risk factors	105 (21.2%)	270 (22.1%)
Arrhythmia/Syncope	86 (17.3%)	214 (17.5%)
Heart failure	60 (12.1%)	108 (8.6%)
Valvular disease	31 (6.3%)	100 (8.2%)
Cardiomyopathy	14 (2.8%)	37 (3.0%)
Other	5 (1.0%)	23 (1.6%)
Reviewer		
Senior House Officer	22 (4.4%)	159 (13.0%)
Registrar	272 (54.8%)	672 (55.1%)
Specialist Registrar	71 (14.3%)	97 (8.0%)
Consultant	129 (26%)	288 (23.6%)
N/A	2 (0.4%)	4 (0.3%)

both the virtual and traditional clinics, except for investigation of murmurs which was performed to a greater proportion in the virtual clinic group ($p = 0.0081$). A table is included in the supplementary data outlining the various subcategories.

Consultants and registrars conducted the vast majority of the clinic reviews in both groups. However, there were significantly less senior house officers ($p < 0.00001$) and more specialist registrars ($p = 0.0003$) involved in the virtual clinic assessments, compared to traditional clinic assessments.

Patient demographics

The average age of patients participating in their appointment was similar in both groups; 61 years in virtual clinic vs 60 years in traditional clinics. There was no difference in age between those cancelling telephone and hospital appointments (56 and 59 years respectively, $p = 0.23$). Over half of the patients reviewed in both groups were males (Table 2). There was a similar distribution of background medical history in patients attending the virtual and traditional clinics. Hypertension and dyslipidaemia were the two most common conditions in both cohorts.

The Canadian Cardiovascular Society (CCS) grading of angina pectoris and the New York Heart Association (NYHA) classification of heart failure severity were used to assess the symptom burden of patients with cardiovascular

Table 2 Patient demographics

	Virtual clinic (<i>n</i> = 496)	Traditional clinic (<i>n</i> = 1220)
Age	60 ± 15.6	61 ± 15.3
Gender		
Male	288 (58.1%)	672 (55.1%)
Female	208 (41.9%)	548 (44.9%)
Medical history		
Hypertension	269 (54.2%)	732 (60%)
Hyperlipidaemia	290 (58.5%)	768 (63%)
Diabetes mellitus	91 (18.3%)	226 (18.5%)
Chronic kidney disease	29 (5.8%)	66 (5.4%)
Coronary artery disease	187 (37.7%)	434 (35.36%)
Previous stroke	21 (4.2%)	66 (5.4%)
Smoking history		
Smoker	80 (16.1%)	182 (14.9%)
Ex-smoker	150 (30.2%)	408 (33.4%)
Never smoker	166 (33.5%)	468 (38.4%)
Not documented	100 (20.1%)	162 (13.3%)

disease and heart failure respectively (Table 3). There were significantly less symptomatic patients (CCS class 2–4) with cardiovascular disease in the virtual clinics than the traditional clinics, 31% vs 40.9% ($p = 0.018248$). However, there was no significant difference in the symptom burden of heart failure patients in either group. Of note, the vast majority of symptomatic patients were in CCS and NYHA class 2, with very few severely symptomatic patients in the higher classes.

Participation

In the virtual clinics, the rate of DNA was 16.2% ($n = 112$) and the rate of cancellation was 12.01% ($n = 83$). In the traditional clinics, the rate of DNA was 10.7% ($n = 176$) and the rate of cancellation was 15.1% ($n = 248$). The reason for patient

Table 3 Symptom burden

	Virtual clinic	Traditional clinic
Cardiovascular disease	<i>n</i> = 195	<i>n</i> = 468
Symptom burden	133 (68.2%)	273 (58.3%)
CCS Class 1	51 (26.2%)	166 (35.5%)
CCS Class 2	9 (4.6%)	23 (4.9%)
CCS Class 3	0 (0%)	0 (0%)
CCS Class 4	2 (1.0%)	6 (1.3%)
Not documented		
Heart failure symptom	<i>n</i> = 60	<i>n</i> = 108
Burden	39 (65%)	57 (52.7%)
NYHA Class 1	16 (26.7%)	40 (37.0%)
NYHA Class 2	5 (8.3%)	10 (9.3%)
NYHA Class 3	0 (0%)	0 (0%)
NYHA Class 4	0 (0%)	1 (1.0%)
Not documented		

cancellation was not documented. There was no significant difference in appointment participation between either group ($p = 0.224$).

Clinic outcomes

There were four main categories of investigations booked for patients on the basis of their consultation: imaging, monitoring, blood tests, and functional testing (Table 4). Transthoracic echocardiography comprised the majority of the imaging studies booked in both the virtual and traditional clinics (62.6% vs 65.8% respectively). Computed tomography of coronary arteries (14.3% vs 10.7%), carotid ultrasound (7.7% vs 10.4%), and cardiac magnetic resonance imaging (7.7% vs 8.6%) made up the majority of the rest of the imaging studies booked in the virtual and traditional clinics respectively. Monitoring investigations included blood pressure monitors, Holter monitors, and event monitors. There were significantly less investigations booked in the virtual vs traditional clinics, 38.5% vs 55.7% ($p < 0.00001$) (Fig. 1). Imaging tests were the most common investigations booked in both the virtual and traditional clinics, with 91 (18.3%) and 383 (31.4%) booked respectively. The relative proportion of the other investigations booked was similar in both groups.

Management changes included alterations to patients' prescription, referral to another specialist service and referral for angiogram and surgical intervention. Medication changes were the most common management instituted in both clinic groups. Of those that had medication adjustments in the virtual clinics, 53.7% had a new medication prescribed, 26.3% had a change made to their medication dose, and 20% had their medication discontinued. The corresponding figures in the traditional clinics were 51.1%, 33.3%, and 15.5% for each category respectively. The overall percentage of patients having a change to their management instituted on the basis of their consultation was significantly lower in the virtual vs traditional clinics, 99 (19.9%) vs 470 (38.5%) patients respectively ($p < 0.00001$). The rates of referral for coronary angiography and surgical intervention were similar in both groups.

The rate of discharges from clinic was higher in the virtual clinics than traditional clinics. There were 143 (28.8%) patients in the virtual clinic and 239 (19.6%) patients in the traditional clinic discharged back to their primary care physician ($p = 0.00003$).

Discussion

The aim of this study was to determine whether virtual clinics affect the manner in which patients are managed. The results of the study gave us an insight into the accessibility of virtual clinics and the practices of clinicians providing the service. Comparing the data to that of the traditional

Table 4 Clinic outcomes

Outcomes	Virtual clinic (n = 496)	Traditional clinic (n = 1220)	
Investigations booked:	191 (38.5%)	680 (55.7%)	<i>p</i> < 0.00001
1 investigation	167	465	
2 investigations	24	186	<i>p</i> < 0.00001
3 investigations	0	29	
Investigations:			
Imaging	91 (18.3%)	383 (31.4%)	<i>p</i> < 0.00001
Blood tests	75 (15.1%)	249 (20.4%)	<i>p</i> = 0.011157
Monitoring	44 (8.8%)	224 (18.4%)	<i>p</i> < 0.00001
Functional testing	7 (1.4%)	69 (5.7%)	<i>p</i> = 0.000107
Patients ≥ 1 management change:	99 (19.9%)	470 (38.5%)	<i>p</i> < 0.00001
Management:			
Medication changes	80 (16.1%)	390 (31.9%)	<i>p</i> < 0.00001
Angiogram booked	13 (2.6%)	40 (3.3%)	
Medical specialty referral	5 (1.0%)	45 (3.7%)	<i>p</i> = 0.002765
Specialist nurse clinic referral	5 (1.0%)	32 (2.6%)	<i>p</i> = 0.036813
Referral for device	2 (0.4%)	8 (0.7%)	
Referral for valve surgery	1 (0.2%)	5 (0.4%)	
Referral for coronary artery bypass grafting	1 (0.2%)	1 (0.1%)	
Outcome:			
Return clinic	353 (71.2%)	980 (80.3%)	<i>p</i> = 0.00003
Discharged	143 (28.8%)	239 (19.6%)	
Not specified	0	1 (0.1%)	

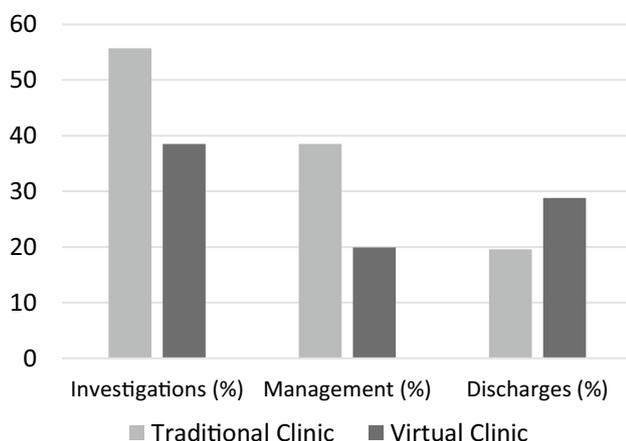
face-to-face hospital clinics helped to identify how practice changed in a virtual clinic setting.

Both clinic groups were well matched with respect to gender, background medical history, smoking status, and symptom burden. In both the cardiovascular disease and heart failure categories, there were very few severely symptomatic patients reviewed in the clinic, suggesting both groups were populated by equally stable patients. With regard to virtual clinics, age bias is a major concern. The

difficulty posed by the use of technology for some elderly patients, as well as visual and hearing impairments, could be a deterrent to telemedicine. The results of this study showed that there was no difference in the age groups scheduled to both the virtual and traditional clinics. Furthermore, there was no difference in the age of patients cancelling their clinic appointments. There was a similar rate of participation for clinic appointments in both groups, indicating that virtual clinics are at least as accessible for patients as traditional clinics.

While there was a significantly lower rate of investigations booked and management changes made in the virtual clinic group, the rate of discharges was significantly higher. The virtual clinics allow for a focused assessment of patients' presenting complaint and as such a more streamlined management plan. Specifically, there was a lower rate of medication changes in the virtual clinic; prescribing physicians are likely to be more cautious in a virtual clinic setting without reliable information on vital signs readily available.

It is also important to consider whether all the investigations booked and management changes introduced in traditional clinics are necessary. The significantly higher rate of referrals to other medical specialties in the traditional clinics may reflect the number of patients presenting to cardiology clinics with non-cardiac medical issues. These ailments

**Fig. 1** Clinic outcomes

could be managed by patients' primary care physician and referred to the appropriate specialist. During face-to-face hospital appointments, there is often increased pressure from patients and their family to investigate longstanding issues and expedite review with our medical colleagues.

The higher rate of discharges from the virtual clinics shows that cardiologists are able to make definitive clinical decisions based on teleconferencing with patients and objective investigation results. A longer study period would be required to assess whether this trend would continue. In the long-term, an increased discharge rate would result in a more efficient cardiology outpatient service and a shorter outpatient waiting list.

Centres in the UK have investigated the benefits of outpatient urology and orthopaedic virtual clinics. Virtual clinics conferred healthcare, environmental and economic benefits by reducing patient miles travelled, decreasing the rate of DNA, and waiting times for new clinic appointments [4, 5].

In the management of patients with inflammatory bowel disease and chronic kidney disease, virtual clinics have been successfully used to free up longer traditional face-to-face hospital clinic appointments for more complex cases [6, 7].

To our knowledge, there have been no studies performed comparing virtual general cardiology clinics to traditional clinics. However, a study performed in another Irish hospital has shown that cardiology advanced nurse practitioner led virtual clinics are safe and effective, resulting in reduced emergency department waiting times, reduced burden on general cardiology outpatient clinics, and economic benefits for the hospital [8].

The virtual clinics have the potential to provide our service with a streamlined and thorough review of an appropriately selected patient cohort. In the post-COVID era, cardiology clinics could be run more efficiently with a hybrid system, incorporating both clinic types. This would allow for face-to-face assessment of patients new to the clinic, patients with limiting symptoms, and those that would require complex management, while a virtual approach could be sought for routine follow up of stable patients.

This study did have some limitations. The study period was short, and a larger sample size in the virtual clinic group would yield more representative data. However, it is important to remember that this study was performed opportunistically, in the confines of a global pandemic. The virtual clinics were conducted by more senior staff compared to the traditional clinics. However, senior house officers are encouraged to discuss all complex cases and major decisions with senior colleagues. As such, we cannot determine whether the difference in seniority of reviewers in either clinic group had a major effect on the outcomes of the clinic appointments. Data collection was dependent on documentation. A survey of patient and clinician satisfaction would have provided interesting subjective data on how different

groups were adapting to the new system. The reason for cancellation was not recorded; this would enlighten us on issues surrounding clinic participation. While our study gives us an insight into the practice of clinicians in a virtual clinic setting, it is unknown how management of patients via telemedicine could affect clinical outcomes. Data was not collected on patients presenting to the emergency department or requiring admission following outpatient consultation, as this was outside the scope of the study. It was noted however that none of the patients reviewed during the study period required direct admission from the clinic or urgent face-to-face review in the case of telephone consultations. Longitudinal studies would be required to determine the impact of this new system on patient outcomes.

Conclusion

This study shows that virtual clinics are a viable alternative to traditional clinics during the COVID-19 outbreak. Despite the need for rapid acclimatisation during the pandemic, virtual clinics may have an important role to play in the delivery of hospital outpatient cardiology services in the future. While a large proportion of cardiology patients require long-term follow up, hospital attendance is often not necessary. A closely collaborative relationship with primary and community care could allow cardiology virtual clinics to be delivered in a safe and efficient manner. Such a service would prevent unnecessary hospital visits for a significant number of patients, which is likely to confer health, economic and environmental benefits for hospitals and the wider community.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11845-021-02617-z>.

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Declarations

Conflict of interest The authors declare no competing interests.

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