





Role of telemedicine in the management of oral anticoagulation in atrial fibrillation: a practical clinical approach

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Compared with face-to-face consultations, telemedicine has many advantages, including more efficient use of healthcare resources, partial relief of the burden of care, reduced exposure to COVID-19, treatment adjustment, organization of more efficient healthcare circuits and patient empowerment. Ensuring optimal anticoagulation in atrial fibrillation patients is mandatory if we want to reduce the thromboembolic risk. Of note, telemedicine is an excellent option for the long-term management of atrial fibrillation patients. Moreover, direct oral anticoagulants may provide an added value in telemedicine (versus vitamin K antagonists), as it is not necessary to monitor anticoagulant effect or make continuous dosage adjustments. In this multidisciplinary consensus document, the role of telemedicine in anticoagulation of this population is discussed and practical recommendations are provided.

First draft submitted: 5 May 2022; Accepted for publication: 22 June 2022; Published online: 13 July 2022

Keywords: anticoagulation • atrial fibrillation • COVID-19 • direct oral anticoagulant • telemedicine • vitamin K antagonist

The objective of telemedicine is to improve patients' health through the use of electronic communication devices and tools [1]. Remote health technologies, tools and services developed in recent years have become a relevant component of the healthcare system for specific conditions (e.g., heart failure). However, the COVID-19 pandemic has had a major impact on the further development of these technologies [2,3]. Telemedicine also improves communication between clinicians through e-mail, video and electronic consultation, and between clinicians and patients through video, telephone, e-mail, remote wireless monitoring and the internet. In addition, patients can benefit from various mobile health technologies, including wearable monitors, smartphones, mobile applications ('apps'), video, e-mail, web portals and games [1]. Artificial intelligence and machine learning in particular will help physicians to optimize resources and provide better medical care in clinical practice [4].

Telemedicine and face-to-face visits are compatible and even complementary. In fact, a patient may require both types of visit during follow-up, depending on their clinical course. As telemedicine has many advantages – and disadvantages – it is essential to determine which type of clinical care is better for an individual patient at each point in time [2].

The advantages of telemedicine over face-to-face visits include more efficient use of healthcare resources (i.e., human, material and economic), partial relief of the burden of care (i.e., fewer office-based visits), avoidance of

unnecessary movement (i.e., reduced exposure to COVID-19 or pollution, reduction of costs for the patient/family etc.), optimization of treatment, reorganization of more efficient care circuits and promotion of self-monitoring (i.e., patient empowerment, reduction of indirect costs) [2,3,5,6]. In addition, data suggest that telemedicine could be associated with a reduction in the number of unfavorable events. A retrospective study performed in Spain showed that compared with scheduled in-person visits, telephone visits during the COVID-19 lockdown period resulted in significantly higher rates of visit compliance and a lower number of ancillary tests and referrals. Compared with traditional care, telephone visits led to 52 and 47% reductions in the combined variable of number of emergency department visits and hospital admissions after 1 and 2 months of follow-up, respectively. In addition, the vast majority of patients were satisfied/very satisfied with telephone visits [7]. The use of apps for smartphones can also improve patients' health. For example, an app has been designed to increase stroke awareness via medication alerts and control of adherence, communication with medical staff, didactic video files and exercise monitoring. Compared with standard of care, this app has improved control of cardiovascular risk factors after a stroke [8].

Telemedicine is also subject to a series of major limitations. In some patients, such as those with sensory disorders, communication between healthcare provider and patient may be problematic. In addition, the lack of nonverbal communication during a telephone visit may also hamper the interaction, although this limitation can be reduced with a video call. Moreover, except for vital signs that the patient can provide (i.e., blood pressure, heart rate, body weight, oxygen saturation), a physical examination cannot be performed, and although some patients can send electrocardiographic tracings electronically, additional tests cannot be performed in most cases. Furthermore, not all patients have adequate access to telemedicine, because of factors such as technical barriers and cognitive impairment. On the other hand, whereas in the USA Medicaid defines telemedicine as involving audio and video equipment, the definition in Spain includes not only audio and video equipment, but also audio-only equipment [2,9]. Additionally, it should not be forgotten that telemedicine is a medical act *per se* and although it has similar regulation rules than face-to-face consultations, it has also some particularities, such as assuring patient privacy through the electronic medical history of the patients that meets with all security measures. Finally, in contrast to other countries, in Spain there are no differences in the billing mechanisms or legal structures via which these services may be offered, as they are covered by the public Spanish National Healthcare System. It only depends on the availability of these services at each center [1,2,5].

In summary, these advantages and disadvantages should be carefully appraised if we are to provide optimal, tailored medical care. Potential gaps can be reduced by structuring the telemedicine visit adequately, overcoming technical barriers and enhancing medical and patient/family/caregiver education [1,2,5].

Limitations are not restricted to patients but may also affect healthcare professionals. These include lack of standardized protocols, differences in clinical practice, lack of specific training and technical barriers. Therefore it is necessary to develop specific and simple tools that promote telemedicine among healthcare professionals based on a multidisciplinary approach. Despite information on the impact of telemedicine on anticoagulation in patients with atrial fibrillation (AF), no complete guidance has been provided to date about how telemedicine should be structured in this context.

On the other hand, although in the majority of cases the management of anticoagulation in AF patients has been provided by physicians, other healthcare professionals may also play a role. For example, it has been reported that a nurse-led AF clinic may be associated with similar control of the international normalized ratio, a higher proportion of patients switching to direct oral anticoagulants, a lower risk of stroke/transient ischemic attack and similar safety rates [10]. In addition, another study showed that the management of oral anticoagulation therapy by pharmacists via a hospital anticoagulation clinic was similar to that achieved by an online anticoagulation clinic, suggesting an alternative for these patients [11,12].

To analyze the role of telemedicine in the management of oral anticoagulation in AF from a practical point of view, a multidisciplinary group of experts (i.e., primary care, cardiology, hematology, internal medicine and neurology) from Spain participated in a forum and produced some practical recommendations. These recommendations were mainly focused on the role of physicians in the therapeutic approach of these patients.

Methods

A search was conducted on PubMed (MEDLINE) using the MeSH terms 'telemedicine' + 'atrial fibrillation' + 'anticoagulation' + 'treatment' until October 2021. Original data from clinical trials, prospective and retrospective studies and reviews were analyzed. Only those articles that provided relevant data were included in this narrative review. Then practical recommendations were provided.

Cardiovascular disease & telemedicine

Cardiovascular diseases are the leading cause of mortality in developed countries, even during the COVID-19 pandemic [5,13–16]. For many years, telemedicine has been widely used in specific cardiovascular conditions, particularly heart failure and device-based monitoring (i.e., pacemakers and defibrillators), generally with satisfactory results. A meta-analysis of 41 studies that included patients with heart failure showed that compared with standard care, structured telephone support and noninvasive home telemonitoring reduced the risk of all-cause mortality and heart failure-related hospitalizations, and improved health-related quality of life and satisfaction with most interventions [17,18]. Similarly, given that remote monitoring of pacemakers and implantable cardiac defibrillators has proven useful for the early detection and management of clinical and technical events, organizational processes must be streamlined to optimize benefits [19].

The COVID-19 pandemic has promoted the development of telemedicine, particularly during lockdown. The approach was aimed mainly at the most vulnerable patients, such as those with cardiovascular disease, in order to decrease the risk of contagion and spread, thus moving from face-to-face consultations to telemedicine consultations [2,5]. While such an approach is challenging, many online resources are being successfully developed, with telemedicine itself becoming an increasingly important channel for patient–physician contact [20]. A recent study showed that nursing teleconsultation has proven to be an appropriate strategy for ensuring continuity of care in patients with cardiovascular disease during the COVID-19 pandemic [21]. The lack of healthcare during this period has been unequivocally associated with greater mortality rates [16]. Given the advantages that have come to light during the pandemic, telemedicine will most likely become a permanent feature of clinical practice in many cases, particularly in patients with chronic conditions such as cardiovascular disease, once the critical situation arising from the pandemic has been resolved [2,5].

Telemedicine in patients with AF

AF is the most common arrhythmia in clinical practice, with an estimated prevalence of 2–4% in adults [22,23]. AF increases the risk not only of stroke, but also of cardiovascular outcomes, including myocardial infarction, heart failure and cardiovascular death [24,25]. This is in line with the European guidelines that promote the use of the simple ‘Atrial fibrillation Better Care (ABC)’ holistic pathway that includes ‘anticoagulation/avoid stroke’ (‘A’), ‘better symptom management’ (‘B’) and ‘cardiovascular and comorbidity optimization’ (‘C’) [22]. As a result, management of AF patients should be based on a holistic approach and not only on thromboembolic complications, across all healthcare levels and among different specialties [22]. Unfortunately, there is a substantial gap between therapies recommended in guidelines and the real-world management of patients in terms of anticoagulation and identification/treatment of symptoms and other conditions (e.g., hypertension, diabetes). In this context, it is essential to develop integrated chronic healthcare models in which telemedicine plays a key role [26,27]. Thus mobile health solutions can support remote management of AF [28].

In this context, several initiatives have been implemented to facilitate the comprehensive management of AF patients through telemedicine. The on-demand TeleCheck-AF approach enables remote app-based assessment of heart rate and rhythm and provides relevant information about its utility on the remote management of AF patients in Europe [29–32]. The Hospital–Community–Family-Based Telemedicine (HCFT-AF) program was developed to promote the integrated management of patients with AF using a specific software or website. Application of HCFT-AF has improved adherence to medication, anticoagulation rates and healthy lifestyle changes [33]. Elsewhere, it has been shown that after a mean follow-up of 291 days, the use of a mobile health technology-supported integrated AF management strategy reduced the risk of the composite outcome of ischemic stroke/systemic thromboembolism, death and rehospitalization by 61% and that of rehospitalization by 68%, compared with standard care [34]. In addition, various studies have shown that despite limitations, mobile health applications may also be a useful tool for the detection of new-onset AF and subclinical recurrence of AF [35–40].

Importantly, telemedicine must be considered a medical act and should therefore be subject to minimal legal, medical and structural conditions to ensure optimal provision of healthcare. In this context, clarifying the basic issues to be covered during telemedicine consultations will improve patient care. Thus the clinical interview should be adequately structured from the beginning. To facilitate this process, **Box 1** summarizes the issues to be addressed in a telephone/video interview with AF patients. The questions have been divided into three issues: symptoms, treatments and specific questions that should be assessed in elderly patients [2,41]. AF is common in frail/elderly persons. In this context, specific factors should be addressed during the interview (‘Five Ms’: mind, mobility, medications, multicomplexity, matters most to me) [41].

Box 1. Questions for a telephone/video interview in patients with atrial fibrillation.**Symptoms**

- Do you feel chest pain, breathlessness, dyspnea, asthenia, fatigability or palpitations?
 - If paroxysmal or persistent AF, how many episodes did you have? How long did they last? Was there a known trigger?
 - If permanent AF, what is your heart rate?
- Can ECG tracings be sent electronically?
- Any bleeding?
- Any neurological symptoms/signs?

Treatment

- For symptoms:
 - Heart rate/rhythm control strategy
 - What treatment are you currently receiving (name and dose)?
 - Do you know your blood pressure and heart rate?
 - Do you have any problems with your medication (adverse effects, adherence)?
 - Do you have any problems for taking different drugs?
 - Are you taking NSAIDs?
 - Can ECG tracings be sent electronically?
 - Is a recent blood analysis available (hemoglobin, kidney function, TSH etc.)?
- Antithrombotic therapy
 - Ask about the criteria of the CHA₂DS₂-VASc[†] scale
 - Are you taking any antithrombotic medication (anticoagulant, antiplatelets)?
 - Do you have any problems with medication (adverse effects, adherence, dose missing)?
 - Do you have any problem for taking other drugs?
 - Have you had major/minor bleeding?
 - In the case of VKAs, how is INR monitored?
 - In the case of DOACs, what dosage do you take? According to the type of drugs, ask about weight, age, kidney function, concomitant treatment.
 - Is a recent blood analysis available (hemoglobin, kidney function)?
 - Ask for specific conditions: recent cardioversion, AF ablation, percutaneous revascularization, scheduled surgery, invasive procedures etc.

Specific questions in elderly patients

- Mind: cognition, orientation in space and time
- Mobility: problems, falls, changes over time
- Medications: name, dose, adherence, adverse effects. Are they all necessary?
- Multicomplexity: comorbidities, other symptoms
- Matters most to me: objectives, preferences, priorities

[†] This scale assesses the risk of stroke using the following criteria: congestive heart failure, hypertension, age ≥ 75 (doubled), diabetes, stroke (doubled), vascular disease, age (65–74) and sex category (female).

AF: Atrial fibrillation; DOAC: Direct oral anticoagulant; INR: International normalized ratio; TSH: Thyroid-stimulating hormone; VKA: Vitamin K antagonist.

Data taken from [2,41].

In the case of the first issue, not only is it important to address symptoms and their severity, but it is also desirable to obtain electronic electrocardiographic data (from applications such as Kardia[®] that record heart rate and heart rhythm) [30,40].

With regard to treatment, questions should focus on both symptoms and antithrombotic therapy. If the patient remains symptomatic, it may be useful for them to provide relevant information such as heart rate, blood pressure and even data from blood tests (e.g., renal function to adjust direct oral anticoagulants [DOACs] dosage, thyroid-stimulating hormone if the patient is taking amiodarone, hemoglobin if the patient has anemia.) in order to better adjust medication (addition, withdrawal or dose modification). It is always relevant to determine whether the patient has had problems with anticoagulation, particularly bleeding. Questions about adverse effects, adherence and concomitant drugs are also essential. As for antithrombotic therapy, if the patient is not anticoagulated, it is mandatory to recalculate the CHA₂DS₂-VASc score at each visit [22]. If the patient is taking a vitamin K antagonist (VKA), we should attempt to monitor the international normalized ratio (INR), particularly in the previous 3 months. If the patient is taking a DOAC, we should check whether the dose is correct according to the patient's clinical characteristics [42].

Table 1. Advantages and disadvantages of telemedicine in the management of anticoagulation in patients with atrial fibrillation.

Patient	Physician	Organization	Process
Advantages			
<ul style="list-style-type: none"> – Convenience – Reduced exposure to COVID-19 – Stabilization of clinical condition – Improved experience for patients and healthcare professionals 	<ul style="list-style-type: none"> – Registration of events not identified by mobile devices – Improved diagnosis/patient management – Facilitates explanation of results – Monitoring of treatment (control of INR and adequacy of dose of DOAC) – Rapid answer to specific questions – Reduced healthcare burden – Artificial intelligence can be useful for automating some procedures 	<ul style="list-style-type: none"> – Shorter waiting list – Facilitates care circuit – Development of specific digital applications that facilitate the integration of data 	<ul style="list-style-type: none"> – Higher capacity for prioritizing patients – Optimizing time of visit – Reduced healthcare burden
Disadvantages/barriers			
<ul style="list-style-type: none"> – Technology barriers/skills – Sensory disabilities – Symptomatic patients – Patients with major bleeding 	<ul style="list-style-type: none"> – Inability to examine the patient, particularly first visits – In some cases, start/switch anticoagulation – Digital/skills gaps – Technology barriers/skills – Lack of specific training 	<ul style="list-style-type: none"> – Lack of infrastructure – Legal regulation – In some cases, impossible to perform/transmit an ECG or blood analysis 	<ul style="list-style-type: none"> – Technological difficulties and disruptions during patient visits – Different languages during telehealth encounters
DOAC: Direct oral anticoagulant; INR: International normalized ratio.			

Anticoagulation & telemedicine

AF-related strokes entail a greater risk of death, disability and recurrence than strokes of other etiologies [43]. As a result, anticoagulation is required to reduce the risk of stroke in patients with AF who are at moderate-to-high risk [22].

Considering the common clinical profile of patients with AF, most patients should receive long-term oral anticoagulation [44]. VKAs effectively decrease the risk of stroke by 64% [45]. However, they have many limitations, particularly the narrow therapeutic window, the considerable variability in the anticoagulant effect, the need for anticoagulant activity monitoring and the need for frequent dose adjustments [46]. In addition, poor control of anticoagulation is common in VKA users [47] and markedly increases the risk of complications [48]. DOACs, on the other hand, overcome these limitations and generally [42] have a better risk–benefit profile than VKAs, with a lower risk of stroke and intracranial hemorrhage [49].

Various studies have shown that telemedicine can improve the management of anticoagulation in patients with AF [50,51]. The team of the Telehealth Anticoagulation and Clinical Thrombosis Service Center improved center-based time in therapeutic range by approximately 46% [52]. Similarly, some authors have shown that the use of telemedicine-based coagulation services translates into improved control of anticoagulation among patients taking VKAs [53], whereas others found that control of INR via telemedicine was at least similar to that achieved with traditional care [54]. The beneficial effect of telemedicine on control of anticoagulation has also been observed during the COVID-19 pandemic [55]. In fact, telemedicine follow-up instead of in-person clinic visits may help VKA monitoring, extending the interval of INR testing and reviewing eligible candidates for switching to DOACs [12]. In addition, it has been reported that eHealth-based management is more cost-effective than regular medical care, mainly due to the lower risk of complications and number of hospital stays, especially those resulting from oral anticoagulation [56]. Telemedicine has also been reported to have a positive impact on patients taking DOACs or switching from VKAs to DOACs; namely, that it increases adherence, even during the COVID-19 pandemic [57,58]. Finally, telemedicine should not be limited to physicians, but also used by other healthcare providers. Thus the EVICOAG project, a novel mHealth, smartphone-based, spaced-learning intervention, improved nurses' knowledge of AF and anticoagulation [59]. In this context, it should be emphasized that telemedicine can enhance communication between healthcare professionals (e.g., physicians, nurses, pharmacists), thus improving management of AF patients.

The advantages and disadvantages of telemedicine in the management of anticoagulation in patients with AF are summarized in **Table 1**. These are addressed in terms of four areas: patient, physician, organization and process.

With regard to the patient, telemedicine makes it possible to safely and efficiently verify anticoagulation treatment. The patient's condition can also be stabilized, as treatment is easily modified, thus potentially improving the

Box 2. Selection criteria for telemedicine and office-based visits in anticoagulated patients with atrial fibrillation.**Telemedicine**

- Patients with appropriate interpersonal skills (or caregiver), including elderly patients
- Patients who are clinically and analytically stable, or who have no major abnormalities
- The procedure has been standardized in healthcare
- DOACs: monitor kidney function periodically[†]
- VKAs: self-management of oral anticoagulation

Office-based visits:

- Elderly/fragile patients or patients with cognitive impairment or sensory disabilities, particularly if the caregiver is not available
- Patients who are not clinically stable
- Complex patients with many comorbidities
- Patients with adverse effects or poor tolerance to medication
- Technology limitations/barriers
- Patients who reject telemedicine
- First visits or when additional tests are required

Telemedicine could be considered, but caution should be exercised

- Elderly/frail patients or patients with cognitive impairment or sensory disabilities for whom a caregiver is available
- Complex patients, with many comorbidities and medications but a stable clinical condition
- Patients with only minor technology limitations/barriers

[†]The frequency depends on the degree of kidney impairment.

DOAC: Direct oral anticoagulant; VKA: Vitamin K antagonist.

experience and satisfaction of both patients and professionals. However, this approach is also subject to a series of barriers or disadvantages that could limit the implementation of telemedicine consultations, particularly technology-related barriers and difficulty communicating on the part of some patients (e.g., patients with sensory disabilities). In addition, it is not practical in very symptomatic patients, including those with major bleeding, in which face-to-face consultations are preferred (Table 1).

With respect to the physician, telemedicine may improve diagnosis and patient management, as it facilitates early identification of medical problems and can enable a simple and rapid explanation of changes in treatment, thus reinforcing adherence to anticoagulant treatment. However, physicians cannot physically examine patients, and a series of digital/skills gaps must be overcome to ensure the maximum benefit of telemedicine (Table 1).

Finally, regarding organization/process, telemedicine clearly reduces the care burden by decreasing waiting lists, facilitating care circuits and prioritizing patients. However, as telemedicine is a medical act, legal regulation should be promoted (Table 1).

The benefits of telemedicine and office-based visits can be optimized in anticoagulated AF patients through appropriate selection of those who would benefit most from this specific type of consultation, considering that each patient can benefit from both types, depending on time and clinical course. Thus telemedicine visits are preferred in patients with appropriate interpersonal skills and stable clinical and analytical data or in whom only some modification of treatment is required. If the patient is taking a VKA, only office-based visits are required to determine INR values every 2–6 weeks according to stability, although in the case of self-monitoring, telemedicine would be the approach of choice. If the patient is taking a DOAC, telemedicine could be preferable; kidney function, age, weight and concomitant medications must be determined periodically for dose adjustment according to the type of DOAC. By contrast, face-to-face consultations may be preferred in certain situations, such as for elderly/frail/complex patients and patients with cognitive impairment or sensory disabilities (particularly if the caregiver is not available), in patients who are not clinically stable (i.e., patients who remain symptomatic, have significant bleeding, poor control of anticoagulation or adverse effects, or who require physical examination or additional tests), and in patients with technology limitations/barriers (Box 2).

The utility of telemedicine in different clinical settings is reported in Table 2. An office-based visit is preferable for the first visit: in most cases (a physical examination or additional tests may be necessary) according to clinical criteria. By contrast, except in decompensated patients, telemedicine is desirable in most follow-up visits, as clinical changes can be easily determined and treatment can be quickly modified, with reinforcement of key messages and

Table 2. Utility of telemedicine in the management of anticoagulation in patients with atrial fibrillation in various clinical scenarios.

Initiation of oral anticoagulation	Follow-up visits	Telemedicine in chronically ill patients
<ul style="list-style-type: none"> – In most cases this visit is office-based – Analyze the clinical profile, medical history, thromboembolic risk – Select the treatment (promote the use of DOACs over VKAs as initial treatment) – Educate the patient: <ul style="list-style-type: none"> ○ Importance of anticoagulation in patients with AF ○ Dosage and importance of adherence ○ Blood analysis: complete blood count, INR in the case of VKAs, kidney function in the case of DOACs ○ Recommendations when a dose is omitted – Organize next follow-up visit – Explain potential complications, drug–drug interactions etc. – Record PROM and PREM 	<ul style="list-style-type: none"> – Promote telemedicine visits – Review clinical changes, particularly visits to the emergency department, hospitalizations, bleeding and thrombotic complications – Record PROMs and PREMs – Consider switching VKAs to DOACs at each visit, ensuring insurance coverage or ability to pay – Review analysis: monitoring of INR (if VKAs), kidney function (if DOACs, as required) – Alerts can be integrated into the system to control anticoagulation – Check adherence and tolerance to treatment, as well as potential complications and drug–drug interactions – Artificial intelligence can be useful for automating some procedures 	<ul style="list-style-type: none"> – Promote telemedicine in the follow-up of stable/asymptomatic patients (additional tests, such as blood analysis, should be scheduled) – Promote switching from VKA to DOAC – Resolve doubts about treatment – Early identification of decompensations – Encourage communication between healthcare levels
Identification of adherence concerns or drug–drug interactions		
	<ul style="list-style-type: none"> – Ask patient about adherence to medication – Verify that the patient has taken the medication from the pharmacy office – Ask about concomitant medications and check for potential drug–drug interactions (specific applications are available) – Recommend taking the anticoagulant in the presence of family/caregiver to improve adherence – Recommend the use of a high-quality website about anticoagulation – Reinforce key messages – Promote health education 	
Change of treatment with oral anticoagulants	Switch from VKAs to DOACs	Bleeding
<ul style="list-style-type: none"> – Explain the reasons for the change – Notify new treatment and dosage (monitoring of INR) – Explain how the change should be made: when to stop the previous treatment and when to start the new one – Verify the patient has understood the change – Explain potential complications, drug–drug interactions and the importance of adherence – Organize subsequent follow-up visits and additional tests 	<ul style="list-style-type: none"> – Consider switching from VKAs to DOACs at each visit to improve outcomes and also to reduce exposure to COVID-19 – In patients with poorly controlled INR, alerts (i.e., poor TTR) can be integrated into the system to improve control of anticoagulation – Encourage communication between healthcare levels 	<ul style="list-style-type: none"> – Explain warning symptoms and how to act in case of bleeding – In most cases, no medical assistance is required – Alerts (e.g., hemoglobin, kidney function) can be integrated into the system to improve early detection – Establish the severity of bleeding – If minor bleeding, consider temporary interruption of anticoagulation – If moderate-to-severe bleeding, recommend visiting the emergency department
After a cerebrovascular event	After hospitalization	After cardiac procedures
<ul style="list-style-type: none"> – Telemedicine is recommended only for long-term follow-up – The first visit should be office based 	<ul style="list-style-type: none"> – An early telephone visit can be useful, although office-based visits are recommended until complete stabilization or when additional tests are required 	<ul style="list-style-type: none"> – Cardioversion/AF ablation: <ul style="list-style-type: none"> ○ Telemedicine is recommended during long-term follow-up of patients who remain asymptomatic, particularly when ECG results can be transmitted online – After percutaneous coronary intervention: <ul style="list-style-type: none"> ○ Telemedicine is recommended during long-term follow-up of patients while they remain asymptomatic and free of complications
<p>AF: Atrial fibrillation; DOAC: Direct oral anticoagulant; INR: International normalized ratio; PREM: Patient-reported experience measure; PROM: Patient-reported outcome measure; TTR: Time in therapeutic range; VKA: Vitamin K antagonist.</p>		

promotion of health education. Given the advantages of DOACs over VKAs (wide therapeutic window, no need for monitoring of anticoagulation, use of stable dose) [42], telemedicine plays an important role in the management of this population. In fact, DOACs facilitate patient follow-up (lower number of visits and visits more easily managed than with VKAs). In addition, most of the information required can be taken from the telemedicine visit (clinical status, adherence to medication, concomitant medications and drug–drug interactions, potential complications, kidney function from periodic blood analysis). In this setting, it would be desirable to use some of the alerts integrated into the clinical history to warn of poor control of INR, thus facilitating early identification of patients who would benefit from switching. In summary, compared with VKAs, DOACs provide added value in telemedicine due to their simplicity of use, as there is no need for monitoring of anticoagulant effect or continuous dosage adjustments. Moreover, switching from a VKA to a DOAC reduces the number of visits. As a result, the need to switch from VKA to DOAC should be actively evaluated at each visit, preferably with automatic alerts. In this context, the use of DOACs that are more easily administered (i.e., once-daily dose, simple dose adjustment, fixed dose) could provide additional benefits for follow-up, such as ensuring that a higher proportion of patients receive

Box 3. Particularities of telemedicine according to the specialty where anticoagulated patients with atrial fibrillation are treated.**Cardiology**

- First visit can be performed through high-quality consultations (office-based visit)
- Follow-up visits can be easily managed through telemedicine (blood pressure, heart rate, body weight can be provided by the patient)
- VKAs can be switched to DOACs using telemedicine
- Patient education may be required to move to telemedicine

Hematology

- A comprehensive approach to control of anticoagulation can be provided through telemedicine

Primary care

- Preference of face-to-face consultations for the first visit or when a relevant change in treatment is required, including oral anticoagulation
- Monitoring of INR (except self-monitoring) favors office-based consultations
- DOACs favor telemedicine

Internal medicine

- First visit can be performed through a high-quality consultation (office-based visit).
- Patients usually have many comorbidities and are polymedicated (anticoagulation is only one of the treatments taken)
- In the case of elderly/frail patients, the (virtual) presence of a caregiver may be required

Neurology

- Patients usually have many comorbidities
- Sensory/neurological disabilities should be considered (e.g., aphasia)
- The first visit should be office based
- Telemedicine is recommended only for long-term follow-up
- In the case of patients with cognitive impairment or sensory disabilities, the (virtual) presence of a caregiver may be required

DOAC: Direct oral anticoagulant; INR: International normalized ratio; VKA: Vitamin K antagonist.

an appropriate dose, thus leading to a reduction in unfavorable outcomes [60–63]. With regard to hemorrhages, minor bleeding (i.e., mild gingival bleeding) can be easily managed during the telemedicine consultation. However, face-to-face visits or even visits to the emergency department are preferable in the case of significant bleeding, according to the intensity of the hemorrhage.

Finally, the use of telemedicine depends on the specialist who treats the patient (Box 3). Thus, whereas hematologists mostly prefer telemedicine, even during the first visit, other specialists recommend a face-to-face consultation for the first visit [64]. In addition, the (virtual) presence of a caregiver may be required in the case of elderly or frail patients, who are frequently treated by internal medicine specialists, and in patients with sensory/neurological disabilities (e.g., aphasia), who are generally treated by neurologists.

Conclusion

Telemedicine and face-to-face consultations are complementary tools that ensure adequate continuity of care, both during the COVID-19 pandemic and beyond. The advantages of telemedicine over face-to-face visits include more efficient use of healthcare resources, improvement of quality of care, partial relief of the burden of care, reduced exposure to COVID-19, optimization of treatment, organization of more efficient care circuits and patient empowerment. However, its use may be limited by technical and legal barriers, sensory impairment and the impossibility of performing a complete physical examination and additional tests. As a result, it is important to identify the patients who will benefit most from telemedicine. Appropriate anticoagulation is mandatory to reduce the risk of stroke in patients with atrial fibrillation. Telemedicine may be an excellent option for long-term follow-up, by promoting adequate management of oral anticoagulants in clinical practice. In addition, using direct oral anticoagulants instead of vitamin K antagonists may facilitate follow-up through a lower number of visits and simpler consultations.

Future perspective

Although telemedicine had been previously used in patients with cardiovascular disease (particularly in heart failure) with encouraging results, the COVID-19 pandemic has markedly promoted the development of

telemedicine [2,3,65,66]. Although telemedicine has some advantages over face-to-face consultations (i.e., more efficient use and organization of healthcare resources, simplification of treatment adjustment, patient empowerment), it also has some disadvantages (i.e., technology barriers/skills, inability to examine the patient, legal regulation). However, it should be emphasized that both face-to-face consultations and telemedicine are complementary healthcare approaches. Therefore the decision regarding the best approach should be individualized according to the clinical situation of the patient at each moment [1,2,5]. As a result, it is expected that the use of telemedicine will increase in the following years, even after the COVID-19 pandemic has been overcome [67].

Ensuring optimal anticoagulation in AF patients is mandatory to reduce the thromboembolic risk [22]. Unfortunately, there is a substantial gap between the recommendations performed by guidelines and clinical practice. This is partially related to the limitations of vitamin K antagonists (VKAs) [44,47]. By contrast, DOACs overcome the majority of limitations of VKAs [60,61]. Remarkably, the introduction of DOACs has led to a reduction in the incidence of ischemic stroke in population-based studies [68]. Telemedicine is an excellent option for the long-term management of AF patients as it facilitates the comprehensive management of this population [2,29–32]. In addition, DOACs may provide added value in this clinical context (compared with VKAs), as it is not necessary to monitor anticoagulant effect or make continuous dosage adjustments, facilitating their prescription in clinical practice [60]. Therefore telemedicine should be considered as a successful tool for the management of AF patients, including the anticoagulation approach, and it is also expected to have a higher use in this clinical context in the near future [69,70].

Executive summary

- Telemedicine has some advantages over face-to-face consultations (i.e., more efficient use and organization of healthcare resources, simplification of treatment adjustment, patient empowerment), but also some disadvantages (i.e., technology barriers/skills, inability to examine the patient, legal regulation).
- Telemedicine and face-to-face consultations are complementary tools that ensure the adequate continuity of care.
- Although the COVID-19 pandemic has led to a development of telemedicine, it is expected that both approaches will remain after the pandemic has been overcome.
- The decision regarding the best approach should be individualized according to the clinical situation of each patient at each moment.
- Telemedicine may be an excellent option for the long-term follow-up of patients with atrial fibrillation, ensuring the appropriate comprehensive management of this population, including chronic oral anticoagulation.
- Direct oral anticoagulants not only overcome the majority of limitations of vitamin K antagonists, but also are associated with a better risk–benefit profile.
- Direct oral anticoagulants may also facilitate the follow-up of patients with atrial fibrillation through telemedicine, and their use should be encouraged.

Author contributions

All authors contributed extensively to the work presented in this paper. All authors have contributed significantly to the conception, design, or acquisition of data, or analysis and interpretation of data. All authors have participated in drafting, reviewing and/or revising the manuscript and have approved its submission.

Financial & competing interests disclosure

V Barrios has received consultancy/lecture fees from Bayer, BMS/Pfizer, Boehringer Ingelheim and Daiichi Sankyo. S Cinza-Sanjurjo has received honoraria for presentations from Bayer, Boehringer-Ingelheim, Daiichi Sankyo and Pfizer-BMS; advisory board fees from Bayer, Boehringer-Ingelheim, Daiichi Sankyo and Pfizer-BMS; and funding for studies from Bayer. J García-Alegria reports consulting fees and/or lectures honoraria from Bayer, Boehringer Ingelheim, Bristol-Myers Squibb and Daiichi Sankyo. R Freixa-Pamias has received honoraria for presentations from Bayer, Boehringer-Ingelheim, Daiichi Sankyo and Pfizer-BMS. F Llordachs-Marques. No potential conflicts of interest were declared by the author. CA Molina reports consulting fees and/or honoraria from Novo Nordisk, Bayer, Pfizer, BMS, Daiichi Sankyo and Boehringer Ingelheim. A Santamaría has received honoraria per conferences from Octapharma, Novo Nordisk, Bayer, Pfizer, BMS, Sobi, Shire, Sanofi, LEO Pharma, Rovi, Daiichi Sankyo, Werfen and Ferrer. D Vivas reports no potential conflicts of interest were declared by the author. C Suárez has received speaker and/or advisory fees from Bayer, Pfizer/BMS, Daiichi Sankyo. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

Medical writing support was provided by Content Ed Net (Madrid, Spain) and was funded by Bayer Hispania.

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