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Telepharmacy for the management of cardiovascular patients in the community[☆]

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ABSTRACT

Telepharmacy is devised to provide pharmacy operations and patient care at a distance and to expand access to healthcare, enhance patients' safety and improve patient outcomes. A variety of technologies, models of care and interventions are used to develop and provide telepharmacy services, serving diversified populations with different pathological conditions, including cardiovascular diseases. Unfortunately, very few randomized controlled studies have evaluated the clinical efficacy of the implementation of telepharmacy services in the management of various cardiovascular conditions, with the strongest evidence being limited to telemonitoring studies in the areas of hypertension and diabetes. Although the clinical efficacy of telepharmacy, and its cost effectiveness, are far from being fully proved, the inclusion of telepharmacy services in healthcare models may offer the unique opportunity to increase access to screening and improve care of cardiovascular conditions.

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Introduction

The effectiveness of the community pharmacist's intervention in improving patients' care by providing certain chronic disease management services has been shown in several trials and systematic reviews carried out worldwide [1–3]. In particular, community pharmacists are well placed to help patients who have established cardiovascular diseases or who are at risk of developing such conditions. The pharmacist may play a role in both primary and secondary prevention of cardiovascular diseases by providing direct interventions such as patient education and counsel-

ing, drug safety management, medication review, monitoring and reconciliation, detection and control of specific cardiovascular risk factors and clinical outcomes, as a support to the physician action. In a recent review of the literature [4] we have documented that the direct pharmacist intervention in patients care, in alternative to a more traditional approach, can favorably affect therapeutic and safety outcomes in different cardiovascular diseases or conditions including diabetes, dyslipidemia, arterial hypertension, ischemic heart disease and heart failure. As a matter of fact, an improved control of hypertension, dyslipidemia or diabetes, effective smoking cessation and reduced hospitalization in patients with heart failure have all been documented following a pharmacist's intervention.

The recent introduction of telemedicine services in the context of healthcare provision models has offered new ways to manage cardiovascular patients by connecting healthcare team members and clinical specialists to provide consultations in settings where specialty services are unavailable, as the case for community pharmacies. In the context of such new healthcare organizational models pharmacists often serve as patient care team members and facilitators of communication between other healthcare providers, and also between healthcare providers and patients. Through the utilization of telemedicine pharmacists can now expand the reach of their intervention and provide remote clinical services in the outpatient or ambulatory care setting with substantial benefit for patients and their managing physicians.

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Table 1

Characteristics of most common currently available telepharmacy services. ECG: Electrocardiogram; HIV: Human Immunodeficiency Virus; COPD: Chronic Obstructive Pulmonary Disease.

Types of technologies

- Internet
- Telephone
- Videoconsultation
- Text or electronic messaging
- e-mail
- Automated electronic reports
- Fax

Types of services or interventions

- Pharmacist-led telephonic clinics
- Post-discharge follow-up
- Medication counseling
- Drug review/monitoring (including adverse events and adherence)
- Provision of drug information
- Remote medication dispensing
- Medication therapy management
- Patient assessment and counseling (including teleconsultation)
- Virtual management within a multidisciplinary team
- Telemonitoring of lab values (e.g. coagulation, blood glucose) and vital signs (e.g. blood pressure, ECG)
- Automated text message reminders or phone calls
- Instructional and educational videos
- Educational websites

Types of conditions managed

- Hypertension
- Diabetes
- Hyperlipidemia
- Anticoagulation
- Heart failure
- Stroke
- Chronic kidney disease
- Depression
- Post-traumatic stress disorder
- HIV
- Asthma
- COPD
- Smoking cessation

In the present review we aim to update the reader on the types of telemedicine interventions delivered by the pharmacist and the current evidence of their clinical impact in the management of the cardiovascular patient.

Telepharmacy services

Telepharmacy, as defined by the American Society of Health-System Pharmacists, is the application of telehealth technology to pharmacy practice in order to provide pharmacy operations and patient care at a distance and to improve patient outcomes, expand access to healthcare, and enhance patients' safety [5]. A variety of technologies, models of care and interventions are used to develop and provide telepharmacy services, serving diversified populations with different pathological conditions (Table 1).

Formerly limited to medication dispensing and review services, telepharmacy is now currently embracing wide and heterogeneous interventions which involve the pharmacist in more professional activities within a multidisciplinary healthcare team, including a primary care physician, a specialist, a nurse, etc. Telepharmacy allows to electronically share measurements of several parameters (e.g. blood pressure or BP, electrocardiograms or ECGs, blood lipids and glucose, body weight, etc.) and information on medications and life style behaviors among care givers and patients. It can also help provide education at distance on various health issues and topics.

Clinical impact of telepharmacy

Although quite popular in some many countries the overall clinical impact of telepharmacy services cannot presently be fully doc-

umented due to the paucity of available studies, the heterogeneity of their designs, disease states managed and outcomes assessed. As a matter of fact, most telepharmacy reports in the literature are primarily limited to descriptive accounts of how such services are structured, implemented and how they operate: few studies report on the evaluation of actual outcomes of these services, and fewer still are randomized, controlled, long-term trials.

According to a recent meta-analysis of 34 studies the most common practice model utilized in an outpatient or ambulatory care setting was a scheduled model of care, with pharmacists delivering interventions via telephone for the management of chronic diseases, mostly diabetes and hypertension [6]. Clinical disease management, patient self-management and adherence were the main types of outcomes used to evaluate the impact of the intervention. The majority of the reviewed studies reported an overall positive impact on outcomes: the overall positive rate was 62.5% for studies reporting adherence, 67.8% for studies reporting clinical disease management (achievement of therapeutic goals in monitored parameters or reduced hospitalization) and 100% for studies reporting self-management (self BP measurement and inhaler use techniques).

These data were confirmed by another recent qualitative systematic review, which focused on existing telemedicine models, and included telemonitoring and video consultation services only, thus excluding follow-up telephone calls, the most common modality of pharmacist-patient interaction [7].

Potential benefits of telepharmacy services

In the context of the pharmacy setting, telemedicine has the major advantage of making available in the community healthcare

Table 2

Potential advantages of telemedicine services delivered through community pharmacies.

- Provision of healthcare services in the community otherwise not available
- Enhancement of the access to care
- Convenient (community pharmacies are accessible at suitable times)
- Short waiting list
- Results quickly available
- Time and cost saving
- Use of professional medical devices and tools (as in a hospital setting)
- Services provided in a professional setting by a healthcare professional
- Test results provided with medical reporting

services which are otherwise lacking (e.g. rural areas) and of enhancing accessibility to healthcare providers and disease management by patients, ensuring continuity of care from the hospital to the community, with a constant support to family doctors.

A list of practical benefits of telepharmacy for the patients is reported in Table 2. The primary advantage of telepharmacy is the easy access to healthcare services, particularly in remote and medically underserved communities. The shortage of doctors and the limited availability in the hospitals or outpatient clinics of certain professional diagnostic tests which are useful for the screening of specific diseases and for the long-term follow-up of treated patients, has led to the setup of dedicated web-based telepharmacy services. The fact that pharmacy is usually within walking distance from home or workplace, is open 6 to 7 days a week, does not require appointment to perform a test and the service is delivered at a lower cost compared with a medical facility, increases the potential for telepharmacy.

Telepharmacy helps health systems to expand services at a lesser additional cost. The economic benefit of telepharmacy relies on the potential of delivering healthcare services in the community at lower costs than in the hospital because, for instance, many pharmacies coordinated by a single doctor team can concurrently serve several patients in large areas. Telepharmacy also saves work and travel time, which are major barriers for access to healthcare services by most of the individuals of the general population.

In general, these benefits are perceived by patients, since studies focusing on evaluations of user satisfaction with telepharmacy services reveal that patients are generally satisfied with the telepharmacy care they receive [8]

Challenges to the implementation of telepharmacy

Undoubtedly, telepharmacy is a great opportunity for improving chronic disease management in the community, but it is sometimes challenging to put into practice, for several reasons (Table 3).

First, as previously discussed, there is limited evidence of its efficacy beyond that of a traditional pharmacist's intervention. This favors the doctors' skepticism towards these services and limits their diffusion in the community.

Second, telepharmacy is a technology-based service. Thus, technology is the driver but also the limiting factor for its implementation. Without a good quality technology, including the use of validated medical devices, adequate hardware, software and connectivity, telepharmacy cannot operate in a proper manner. Setting up a telepharmacy service involves not only compliance with technological requirements, but also considerable time, effort and money.

Third, effective telepharmacy services should be based on standardized healthcare provision models and need proper regulations which may differ from country to country. In some countries, for instance, such services are not allowed or even prohibited, whereas in others such as USA, Italy and other European countries a proper legislation is available [5,9,10]. Unfortunately, in many countries, despite the widespread potential of telepharmacy, the laws and

policies that govern pharmacy operations do not adequately address the growing industry. Because telepharmacy is continuously evolving with the implementation of new services and technologies, laws and regulations will need to be implemented and evolve as well. Major policy issues are related to types of services which can be offered by the pharmacist and the education, training, certification and licensure of the pharmacist, the type of technology used, etc. In places where telepharmacy laws exist (e.g. USA), there is a lack of uniformity among various jurisdictions and thus execution and implementation of comprehensive and uniform telepharmacy regulations and services is still a challenge.

Fourth, reluctance or inability to use modern technologies may limit the implementation of telepharmacy services both from the pharmacist's and patient's perspective, particularly in case of elderly people.

Fifth, since telepharmacy involves the collection, transmission and reposition of personal and health-related information over the Internet, security and privacy of the information becomes a major issue. Data sharing of information collected through telepharmacy services with other healthcare professionals increases the risk of security breach. Thus, the security and integrity of patient data is of paramount importance when determining the information technology setup of a telepharmacy system.

Sixth, in countries making use of telepharmacy services the integration of these systems to the traditional healthcare systems has not been implemented. The integration of telepharmacy services in the national healthcare systems and the connection of telepharmacy services among different countries is a mandatory but challenging, time-consuming and expensive task that requires harmonizing the healthcare systems and related governing laws and setting up proper rules and regulations.

Seventh, telepharmacy services are not yet reimbursed: individuals have to pay for these services and the expenditures are not covered by private or public health insurances. This limits the use of these services by patients eventually needing them.

Last, but not least, the implementation and dissemination of efficient telepharmacy services require closing the care loop between the pharmacy management and the traditional care management team. Telepharmacy has many promising benefits but also has the risk to create a digital silos of care that cannot communicate with each other. Telepharmacy, particularly when including the support of insurers with independent clinical care teams that contact patients routinely after discharge and intervene with drug or BP or chronic disease management, may oust the referring physician or clinical team from the disease management process. This may lead to problems in communication that impact efficiency and patient care and may further be complicated by the fact that telecare models engage patients more actively in the management of their conditions. Patients have more responsibility, since they are receiving care, information and services in-person, through software applications and tools and connected services. This unprecedented control over their health status and greater responsibility for their own care may turn into unfavorable outcomes if not properly managed in term of communication across the healthcare team members.

Telepharmacy for cardiovascular patient management

Few randomized controlled studies described the implementation and outcomes of clinic-based telehealth programs involving pharmacists or multidisciplinary teams where the pharmacist was involved in the management of various cardiovascular conditions. The strongest evidence for effectiveness of telepharmacy for the cardiovascular patient is restricted to telemonitoring studies in the areas of hypertension and diabetes management. This evidence will be presented and discussed in the next sections of this review.

Table 3
Barriers to the implementation of telepharmacy services in the community.

- Limited evidence of clinical efficacy
- Lack of adequate infrastructure and equipment
- High implementation and maintenance costs
- Poor informatics literacy of healthcare workforces and patients
- Privacy and security of electronic transmission of health information
- Lack of integration with national traditional healthcare systems
- Lack of reimbursement models for services
- Potentially poor integration between telepharmacy and traditional patient management

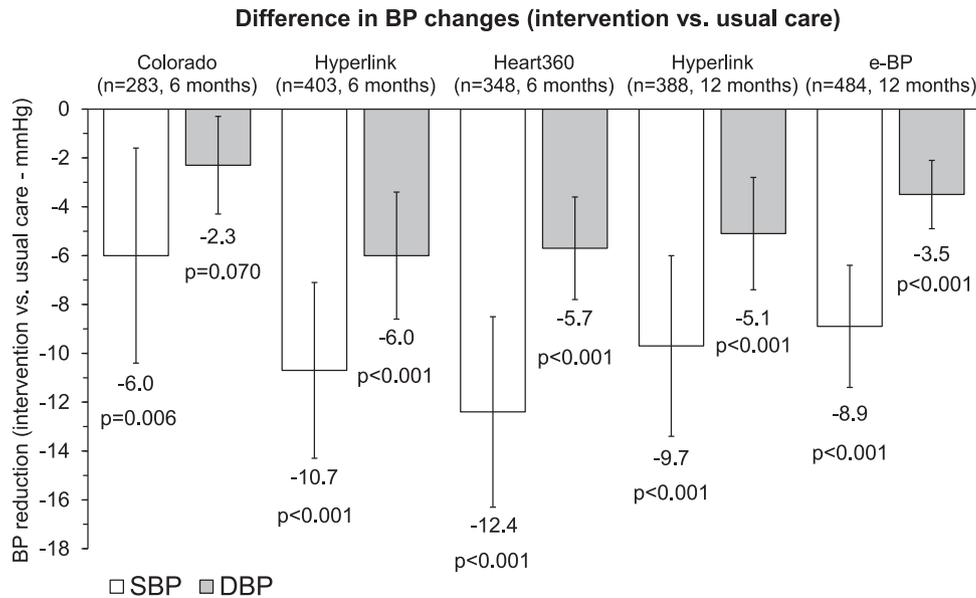


Fig. 1. Difference in systolic blood pressure (SBP) and diastolic blood pressure (DBP) reductions with a telepharmacy intervention vs. usual care in four studies based on BP telemonitoring in community pharmacies. Data are shown as averages and 95% confidence interval. The name of the study, the number of subjects included in the analysis and the time point of the evaluation (in months) is indicated [12,17,21,26].

Hypertension

The effectiveness of telepharmacy in improving clinical outcomes in hypertension has been documented by four large randomized controlled trials (Table 4) [11–26].

In all studies BP reductions following the pharmacist's intervention were larger than those in the usual care group, either at 6 or 12 months, depending on the study design and endpoints (Fig. 1). BP control significantly improved in all studies, but one. Interestingly, the benefit of the pharmacist-led care persisted during the 6 to 12 months following the withdrawal of the intervention in two studies, whereas in the Improving BP in Colorado the proportion of patients with good BP control was similarly poor in both groups, and only patients who improved the adherence to hypertensive medications also gained a good BP control [17,18]. Subgroup analyses revealed that in general patients at higher cardiovascular risk (e.g. severe hypertensive patients, diabetics and patients with chronic kidney disease) had the major benefit from the intervention.

The medication regimen was intensified after the intervention and the adherence to treatment increased, although the latter was not significantly different from that reported by the usual care group. The Hyperlink study also assessed the adherence to the intervention program documenting a high adherence to both BP telemonitoring (73% of patients took at least 6 BP readings per week) and phone case management visits (88% of expected visits were attended), thus indicating that this approach is feasible and effective [21,22]. However, certain groups of patients, such as those in a

younger age, women, those with lower education, and minorities, may need extra adherence support.

Thus, current evidence from randomized studies in hypertensive patients suggests that the synergy between BP telemonitoring and pharmacist case management of patients may facilitate high BP screening and detection. Furthermore, adding web-based pharmacist care to BP telemonitoring and web-provided education on life style may be particularly effective for improving BP control in treated hypertensives.

Diabetes

As for hypertension, studies performed in diabetics assessed telepharmacy models mainly including telemonitoring. The efficacy of pharmacist's care on HbA1c and blood glucose levels via telemedicine to patients with diabetes has been tested in few observational prospective studies.

An early study included 75 patients with diabetes which were assigned to BP, glucose and body weight telemonitoring plus education in the form of messages through the devices over a 6 month period (intervention group) [27]. Pharmacists checked the parameters entered by patients and intervened in the presence of out-of-range values, being able to make medication changes under a collaborative practice agreement with the managing physician. The control group consisted of 75 diabetic patients not receiving any telemedicine intervention, identified from a registry of patients visited during the same timeframe through retrospective chart review (control group). At the end of the study period, the

Table 4

Summary of randomized controlled studies based on telepharmacy interventions in hypertensive patients in a community setting. BP: Blood Pressure.

Study	Number of subjects	Follow-up duration (months)	Characteristics of the pharmacist's intervention	Main results
e-BP (Electronic Communications and Home Blood Pressure Monitoring) [12–16]	730 247 usual care 246 intervention without pharmacist 237 intervention with pharmacist	12	Pharmacist care management delivered through web communication together with home BP telemonitoring and education	<ul style="list-style-type: none"> • After 1 year significant improvement of BP control in patients managed by the pharmacist plus web communication compared to usual control (56 vs. 31%; $p < 0.001$) and BP telemonitoring and web training only (36%; $p < 0.001$) • Persistence of the effect due to the pharmacist-led care 1 year after withdrawal of the intervention (60% vs. 52% usual care and 48% BP telemonitoring only; $p = 0.110$ and $p = 0.010$) • A 1% improvement in BP control rate with BP telemonitoring and web-based pharmacist care costs 15.26 euros relative to BP telemonitoring and web training alone • Barriers to implementation into community practices included a pharmacist unfamiliar to the subject, lack of information technology resources, provider resistance to use a single management protocol • The effect of the web-based pharmacist care is mostly explained by home BP telemonitoring, secure messaging and antihypertensive medication intensification
Improving Blood Pressure in Colorado [17–19]	283 145 usual care 138 intervention	6	Clinical pharmacist management with physician oversight plus patient education and home BP telemonitoring	<ul style="list-style-type: none"> • At 6 months BP reductions were greater in the intervention vs. usual care group ($-13.1/-6.5$ vs. $-7.1/-4.2$ mmHg, systolic and diastolic BP, $p = 0.006$ and $p = 0.07$) • The proportion of patients achieving BP goal at 6 months was similar between the two groups (36 vs. 35%, $p = 0.890$) • Intervention patients had a greater increase in medication regimen intensity • No difference in the proportion of adherent patients between the two groups • 6 months after the end of the study, when patients returned to their usual care setting, the proportion of patients with good BP control was poor (51.5% in the intervention and 46.9% in the usual care group) • 86% of the intervention patients and 62% of the usual care patients reported a positive effect of the study on them
Hyperlink (Home Blood Pressure Telemonitoring and Case Management to Control Hypertension) [20–25]	450 222 usual care 228 intervention	6 to 18	In-person intake visit and phone visits, and antihypertensive therapy adjustment after receiving transmitted home BP data, under a collaborative practice agreement with the clinics' primary care team	<ul style="list-style-type: none"> • Improved BP control with pharmacist's intervention after 6 months (BP telemonitoring 72% vs. usual care 45%; $p < 0.001$) and 12 months (71% vs. 53%; $p = 0.005$) • Persistence of the effect during 6 months of post-intervention follow-up (72% vs. 57%; $p = 0.003$) • High adherence to BP telemonitoring (73%) and phone case management visits (88%) in the BP telemonitoring group • The proportion of subjects adherent to antihypertensive medication was similarly high in both groups (88% intervention vs. 78% usual care group; $p = 0.510$) • Most of the explained BP telemonitoring effect attributable to the combination of self-monitoring (19%) and medication intensification (24%) • The effect of the intervention was larger in patients who were younger, did not have diabetes, had high diastolic BP, added salt less than daily in food preparation, and took less antihypertensive medication classes at baseline
Heart360-based study [26]	348 175 intervention 173 usual care	6	Home BP telemonitoring (American Heart Association Heart360 web application) plus clinical pharmacy specialist reviewing BP medication regimen, providing counseling on lifestyle changes and adjusting or changing antihypertension medications as needed	<ul style="list-style-type: none"> • At 6 months the proportion of patients attaining BP control was significantly ($p < 0.001$) higher in the intervention than in the usual care group (54 vs. 35%) • The impact of the intervention was larger in the subgroup of subjects with diabetes mellitus or chronic kidney disease • The intervention group had more e-mail and phone contacts, and greater medication regimen intensification • The satisfaction rate was larger in the BP telemonitoring group (58 vs. 42%; $p < 0.001$)

frequency of patients achieving an HbA1c goal of <7% was significantly ($p < 0.01$) larger in the telemonitoring intervention group (34.7% vs. 14.7% control group). Patients who received the telemonitoring intervention had also significantly lower mean HbA1c levels after 6 months (7.8 versus 8.8%, $p < 0.001$), but no differences between groups were found for BP, low-density lipoprotein cholesterol and body mass index.

A small uncontrolled study enrolled 28 recently diagnosed adults with diabetes and HbA1c >8% which received for 16 weeks an intervention based on a combination of telephonic contacts by the pharmacist and telemonitoring of blood glucose, BP and patient-reported symptoms [28]. Pharmacist's interventions consisted of tailored medication therapy management recommendations, lifestyle modifications, and adjustments of medications. After 16 weeks HbA1c and fasting blood glucose significantly ($p = 0.001$) decreased compared to baseline (from 9.8% to 8.5% and from 178 mg/dL to 163 mg/dL, respectively). Despite significant reductions in HbA1c and blood glucose from baseline, there was no significant change in patient activation levels. The same results were observed in a small prospective pilot study including 26 veterans with diabetes, based on videoconference visits over a 6 month follow-up period [29].

A non-randomized parallel group controlled study conducted in 103 veterans with uncontrolled type 2 diabetes at four outpatient primary care clinics evaluated the effect of pharmacist's intervention vs. usual care during a 6 month time span [30]. The intervention consisted of a home monitoring device that allowed patients to collect blood glucose values and to interact face-to-face during remote visits with pharmacists and physicians. Both groups showed significant lower mean values of HbA1c after 6 months as compared to baseline (6.9% intervention vs. 7.5% usual care group), but no between-groups difference ($p = 0.198$). Conversely, goals for HbA1c (<7%) were met in a significantly ($p = 0.001$) larger proportion of patients receiving the intervention (69% vs. 36% usual care). This appeared to be due to an intensification of the glucose-lowering medications in the pharmacist-led group.

Very recently, the impact of a remote clinical pharmacy service in improving guideline adherence and secondary measures of key cardiovascular risk factors, including HbA1c, in primary offices in rural and small communities has been tested in a randomized controlled study including 302 subjects [31]. After 12-months the improvements in outcomes were modest, in part because of higher than expected baseline guideline adherence in the control group. Disappointedly, in diabetics the proportion with HbA1c at goal at study end was only marginally and not significantly ($p = 0.100$) larger in the intervention group (30.8% vs. 21.0% control).

Other observational studies evaluated the impact of remote management of diabetic patients by pharmacists, but they were either based on telephone calls or faxing of information [32,33] or had a retrospective design [34]. These studies showed no long-term efficacy of the intervention on HbA1c values.

Other cardiovascular conditions

The number of randomized controlled studies assessing the impact of telepharmacy services in various cardiovascular conditions, excluding hypertension and diabetes, is quite small. Most of these studies are observational in their nature or they are limited to small size case reports.

A telephone-based intervention providing education and counseling on disease management by pharmacists in post-discharge patients with heart failure resulted in reduced rate of hospital admission within 30 days of the acute care admission compared to usual care [35]. A pharmacist-delivered intervention positively affected adherence to cardiovascular medication in two different studies enrolling altogether 789 cardiac patients which were

followed-up for 6–12 months [36,37]. However, the adherence was high also in the control group and not significantly different from that recorded in the patients receiving the intervention (89.9% in the usual care group vs. 88.8% in the intervention group with $p = 0.730$ in the first study; 90.0% vs. 88.0%, with $p = 0.510$ in the second study).

Telepharmacy anticoagulation clinics are quite popular. However, there is only one prospective observational study evaluating the efficacy of such a service [38]. The study involved a small sample of male veterans ($n = 38$) and the intervention was based on a video telehealth technology: telehealth technicians measured International Normalized Ratio (INR) values and vital signs, and transmitted the results to the pharmacist for remote evaluation. The control group was based on face-to-face visits with the pharmacist. During the 6 months of the study the mean percentage of time patients' INR values were within the therapeutic range remained stable (about 81%, compared with about 77% under the face-to-face clinic model), and a high level of patient satisfaction was maintained showing the effectiveness of the service.

Few studies evaluated the potentials for ECG telemonitoring in community pharmacies. Lowres et al [39] tested the feasibility and cost-effectiveness of performing ECGs with a smartphone with an automated detection algorithm for the screening of atrial fibrillation in community pharmacies, and determined the cost-effectiveness of this strategy. Newly identified atrial fibrillation cases were found in 1.5% of the 1,000 customers visiting the pharmacy. The automated ECG algorithm showed 98.5% sensitivity for atrial fibrillation detection and 91.4% specificity, compared to a reference 12-lead standard ECG. The intervention resulted also cost-effective with an incremental cost-effectiveness ratio of 3,142 Euros per Quality Adjusted Life Year gained and 15,993 Euros for preventing one stroke. A case report study documented the effectiveness of mobile ECG monitoring in community pharmacies for the risk management of QT-prolonging drugs [40].

A summary of the level of benefit provided by telepharmacy services according to current scientific evidence is available in Table 5.

Telepharmacy services: the American experience

The telepharmacy model is fairly well developed and very successful in the USA, driven primarily by a large retail pharmacy network, which provides some healthcare service in pharmacies. This network is going to expand its influence, in terms of type of services, affordable costs and payor integration with the recent announcement of the merging of the retail pharmacy and provider chain (CVS stores and Minute Clinics) with a health insurance company (Aetna) [41,42]. The retail pharmacy network currently offers an app-based ability to refill medications and pickup prescriptions, obtain education and in some cases, access some diagnostic services (e.g. blood pressure and blood glucose check), through the Internet. Such retail clinics have the potential to close the loop between traditional providers (nurse practitioners and doctors) by placing clinics within the store and in some instances, forming strategic partnerships with large traditional care facilities to off-load their ambulatory volume or as a way to refer patients with complex conditions that cannot be handled in the retail clinics.

The Tholomeus web-based telemedicine service and the Italian experience

In Italy we have devised, developed and validated a web-based telepharmacy service which is currently used in several community pharmacies [43].

The service is aimed to facilitate the screening and management of the most common chronic cardiovascular (arterial hyper-

Table 5

Level of benefit of telepharmacy interventions on clinical and economic outcomes in cardiovascular disease. BP: Blood Pressure; INR: International Normalized Ratio; ECG: Electrocardiogram.

Outcome	Target condition	Level of benefit
BP	Arterial hypertension	+
Blood glucose and HbA1c	Diabetes mellitus	+/-
Blood cholesterol	Dyslipidemia	-
INR	Anticoagulation	+/-
ECG	Arrhythmias, QT prolongation	+/-
Medication adherence	Cardiovascular therapy	-
Re-hospitalization	Heart failure, coronary heart disease	+/-
Healthcare costs	Hypertension, atrial fibrillation	+/-

tension, ischemic heart disease, arrhythmias, syncope and peripheral artery disease), lung (chronic obstructive pulmonary disease, asthma and obstructive sleep apnea syndrome) or metabolic diseases (diabetes mellitus and dyslipidemia). In particular the fields of application are the screening of healthy subjects (e.g. certification for sport activities, occupational medicine, pre-operative check, etc.) and of subjects at risk (e.g. positive family history for cardiovascular, pulmonary or metabolic diseases) or of individuals with an established chronic condition. The proposed approach should help expand patient access to screening tests in collaboration with the general practitioner, the cardiologist or other specialists and other healthcare professionals and closely monitor treated patients during their follow-up.

A flow-diagram of the operation of the system is summarized in Fig. 2.

The service is managed by a technical (engineers, call center operators) and by a medical reporting team and provides either professional diagnostic tests or home monitoring tools plus medical counseling and teleconsultation to patients. The web-based platform may be accessed also by the patient's referring physician and by other healthcare professionals in charge. The system is developed according to major current guidelines and reporting standards. All services are clinically validated, the system is certified as a medical device and is registered in the repertoire of medical devices of the Italian Ministry of Health. In order to ensure high quality standards to patients and their doctors, pharmacists need to be trained and certified before starting using the service. For pharmacists regularly using the system, successful re-certification on the basis of the average quality of the service provided in the previous year is required in order to continue managing the system and providing the telepharmacy services. Security and privacy of patient's personal data collected at the pharmacy site are ensured by access to the website with a password automatically expiring every three months and by encryption transmission protocols (S-HTTP).

Diagnostic tests are obtained through clinically validated and certified medical devices and include 24-h ambulatory BP monitoring or ABPM (with the option of atrial fibrillation detection and evaluation of central BP and pulse wave velocity), 7-day home BP monitoring (with the possibility to take few readings during the first hours of night sleep), office BP measurement (with simultaneous double arm measurement and evaluation of ankle-brachial index), ECG at rest and over the 24–48 h, simple spirometry, rest oximetry or nocturnal oximetry, cardiorespiratory polysomnography and glucose and lipid profile from capillary blood taken from the fingertips. In order to obtain a diagnostic test the patient has to visit the pharmacy with a family physician's prescription. In most cases the test is carried out immediately by the pharmacist and the data recorded by the device and temporarily stored in its memory are uploaded on the web-based telemedicine platform, by plugging the device to a personal computer with a USB cable. Data are then forwarded through the Internet to the central server of the telemedicine center where they are analyzed and a medical report

of the test is provided in short due time by trained and certified medical specialists. The report can be viewed directly on the website or on a smartphone through a dedicated app and is also provided via e-mail. When uploading the test on the web platform the pharmacist can enter in the system all the relevant patient's clinical information (e.g. current therapies, main concomitant diseases, symptoms, etc.) thanks to the availability of an electronic health record tool. The medical report has been developed in order to provide the minimal amount of information required to the family doctor or specialist to make an adequate diagnosis. For practical reasons, all information is summarized, when possible, on a single page (so called "one-page report"). The medical reports are marked with a proprietary digital seal which certifies the author and the source of the report, thus ensuring quality and traceability of the test.

The smartphone app linked to the web-based platform allows patients to measure several parameters at their living site through wireless medical devices with bluetooth capability. Typically, measurement of BP, single channel ECG, lung function, body weight and body fat composition, body temperature, peripheral blood oxygen saturation, blood lipids and glucose, are provided within the system for home use. The app is connected to the pharmacist and the patient's referring physician, which are regularly notified about the patient's status. An electronic diary for collection of clinical information and adherence to therapy is also provided with the app.

The TEMPLAR project: how a web-based telepharmacy service can help manage the cardiovascular patient

In Italy, the Tholomeus telepharmacy service described above has been used by community pharmacies since 2010. This has allowed us to setup the TEMPLAR Study (TEleMonitoring of blood Pressure in Local phARmacies), an observational, cross-sectional, multicenter study aiming at assessing the potential advantage of BP telemonitoring and telecardiology in community pharmacies for screening and follow-up of hypertension and cardiovascular diseases. We have collected so far 26,443 ABPMs and 23,492 resting or ambulatory ECGs in as many patients, in 785 community pharmacies. In terms of quality of the service, the performance of the pharmacists was good, with 95.2% of ABPMs and 95.8% of ECGs labeled as of good or average quality, and thus assessable. Most subjects (53.8%) had controlled ambulatory BP (24-h average <130/80 mmHg), with a larger proportion in treated individuals (59.8 vs. 51.4% untreated). As far as ECG diagnosis is regarded, a normal tracing was recorded in 63.8% of subjects. The most common ECG abnormalities were premature ventricular or supraventricular beats (14.3%) and sinus tachycardia or bradycardia (8.6%) (Fig. 3). Interestingly, in 19.2% of subjects the ECG allowed to make a new diagnosis, to check for the patient's health status and to refer the patient to the specialist for further investigation and treatment.

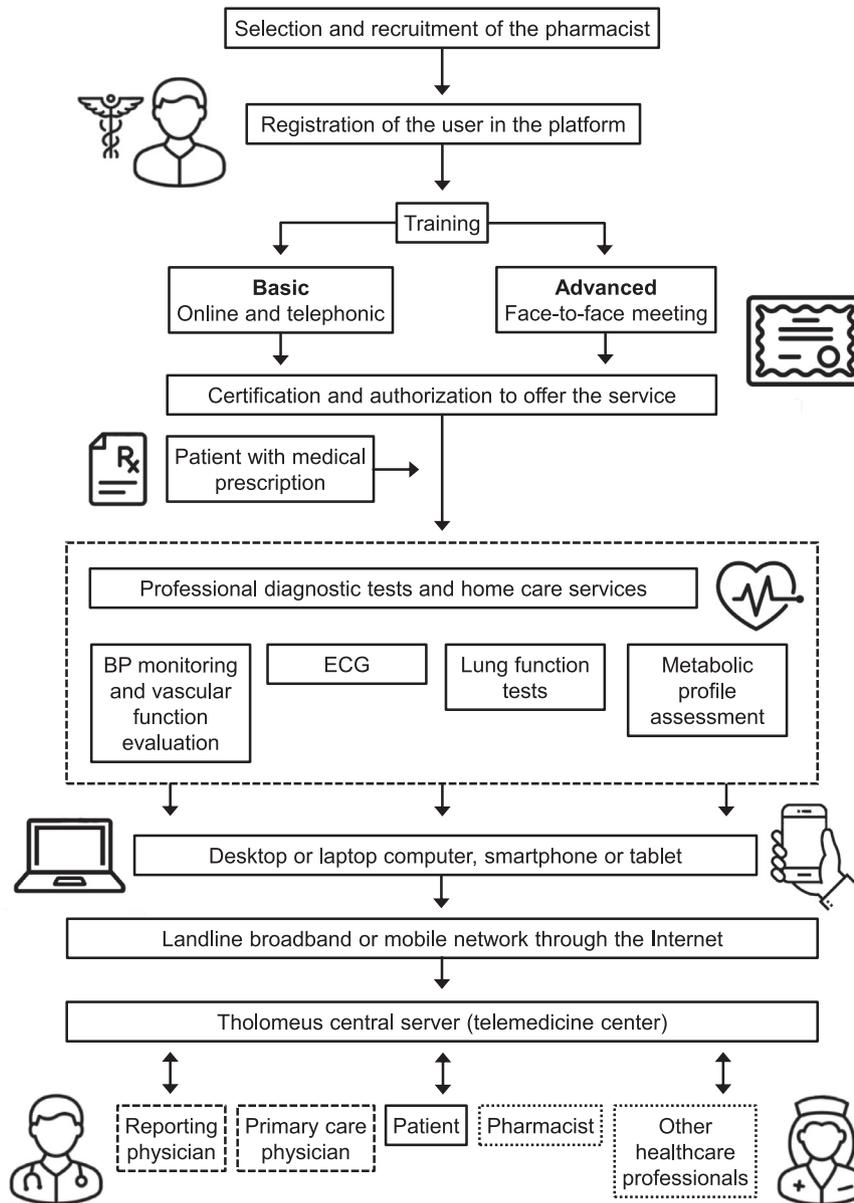


Fig. 2. Workflow of the Tholomeus (Telemedicine and Home teleMonitoring for Medical surveillance of chronic diseases) web-based telemedicine system used in community pharmacies in Italy. BP: Blood Pressure; ECG: Electrocardiogram [43]

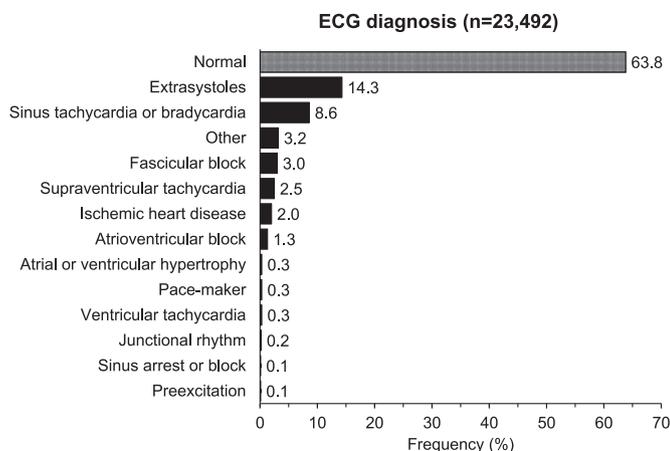


Fig. 3. Frequency (in percentage, %) of types of diagnosis in subjects who performed resting or dynamic ECG in the TEMPLAR project.

Thus, the preliminary evidence from the TEMPLAR Study suggests that a telemedicine service providing medical reporting of ABPM and ECG tests with medical counseling, carried out in community pharmacies, may facilitate cardiovascular screening and detection of potentially dangerous situations requiring medical attention.

Conclusions

Telepharmacy is a healthcare service growing in popularity, which involves the pharmacist in a multidisciplinary healthcare team. It has the ability of shifting the cardiovascular patient management towards a value-based care and a more patient centered model driven by outcome and quality measures. Although the clinical efficacy of telepharmacy, and its cost effectiveness, are far from being fully proved, and the few studies performed so far led to controversial, often disappointing results, yet the inclusion of telepharmacy services in healthcare models has the potential to of-

fer the unique opportunity to increase access to screening and improve care of cardiovascular conditions.

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