Sudarshan Publications

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Pharma Research

An International Peer Reviewed, Indexed Journal

10.62655/s-epub.2022.v14.i01.pp25-32

TELEPHARMACY SERVICES: MODELS, OUTCOMES AND IMPLEMENTATION BARRIERS

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Article info

Received date:31-08-2021
Accepted date:20-12-2021
Published date:11-04-2022
ISSN;0975-8216

Keywords:

Telepharmacy, Pharmacy services, Telehealth, Rural pharmacy, Implementation barriers

Abstract

Telepharmacy delivers pharmaceutical care at a distance through communication technology and has expanded from rural dispensing pilots to hospital, outpatient and pandemic-era services. This narrative review summarises published literature on the main telepharmacy service models, their reported outcomes and the barriers to implementation. It reports no new data. Studies of remote dispensing suggest that safety and quality are comparable to conventional practice, and outpatient services often show improved clinical measures, but evidence is largely descriptive, economic data are weak, and regulatory, technical, professional and patient-related barriers continue to limit uptake. Better controlled evaluations and attention to equity are needed.

1. INTRODUCTION

A pharmacist who is not in the room can still check a prescription, counsel a patient or supply a medicine. That simple idea underlies telepharmacy, defined in professional statements as the delivery of pharmaceutical care through telecommunications to patients at a distance [1, 2]. The term covers a wide range of activities, from a pharmacist reviewing orders for a hospital hundreds of kilometres away, to a video consultation about inhaler technique, to a rural pharmacy supervised remotely with a technician on site. It has grown from a few pilot projects at the end of the twentieth century to an established part of service planning in several countries [3, 4].

The reasons for its growth are mostly practical. Rural communities lose pharmacies when owners retire or margins shrink, and patients are left with long journeys for medicines [5, 6]. Small hospitals cannot staff a pharmacist around the clock. Ambulatory

clinics have more patients needing medicines review than pharmacists to see them. Policy documents on digital health, including the World Health Organization global strategy and its earlier survey of telemedicine, treat remote services as one way to extend scarce professionals to places that lack them [7, 8]. Whether telepharmacy delivers on that promise is a question about outcomes, costs and acceptability, not only about technology.

The idea is not new. Wootton, writing in 1996, welcomed telemedicine cautiously and warned that enthusiasm had run ahead of evaluation, a theme that has been repeated for telepharmacy decades later [4, 9]. Early papers described what could be done with a video link and a fax machine, while later ones asked whether it should be done and with what result. That shift from feasibility to effectiveness marks the maturity of the field and explains why a review today has to weigh the quality of evidence as carefully as the number of services [3, 10].

This article is a narrative review of published literature on telepharmacy services, their reported outcomes and the barriers to implementing them. It reports no new data and no original survey. The text first describes the main service models, then the outcomes reported for dispensing, hospital and outpatient services, and the pandemic experience, before discussing technical, regulatory, professional and patient-related barriers, and the practical implications for services. The review closes with the limits of the evidence, which is more descriptive than experimental.

2. SERVICE MODELS

The oldest and best-documented model is remote dispensing in rural community pharmacy. In the North Dakota Telepharmacy Project, a pharmacist located elsewhere supervised dispensing by a trained technician through audio and video links, with checks of prescriptions and products by camera before supply [5]. The aim was to reopen pharmacies in towns that had lost them. Australian groups described a similar approach for isolated communities, and the model has since been taken up in other parts of North America and elsewhere [3, 6]. Regulation typically limits how far the remote site may be from the nearest conventional pharmacy and sets requirements for technician qualifications.

Hospital telepharmacy is the second main model. Remote pharmacists review medication orders, check doses and interactions, and verify compounded preparations such as intravenous admixtures by video, supporting smaller hospitals that do not have a pharmacist on site, particularly out of hours [2, 11]. Garrelts and colleagues described a multihospital system in which remote order verification extended pharmacy coverage and reduced cost [11]. In the same category are services for hospital outpatients, such as the delivery of medicines and counselling for specialist drugs, which expanded rapidly when attendance at hospital became difficult [12, 13].

Third come clinical services in ambulatory care. Pharmacists provide medication review, chronic disease management and counselling by video or telephone, often integrated with a physician team, and the literature on these has been summarised in narrative and systematic reviews [14, 15]. Diabetes, hypertension, anticoagulation, asthma and HIV are the usual topics. Many services are not telepharmacy in a strict sense because they are part of wider telemedicine programmes, but the pharmacist's role is clearly defined, and the outcome data are among the most useful available [1, 14, 15].

Supporting technology varies. At one end are simple telephone calls; at the other are videoconferencing platforms, electronic records with shared access, automated dispensing cabinets and kiosks, barcode verification and image capture of products and prescriptions [1, 3]. Angaran's early review noted that the technology available in the 1990s was already enough for most functions, and that the limits were organisational and regulatory more than technical [4]. That view still holds, although patient-facing tools have improved. Which model suits a given setting depends mostly on the problem to be solved, so comparisons across models need care [3, 16].

Some models are hybrids. A pharmacist may work in a conventional pharmacy and also conduct remote counselling sessions for a

partner clinic, or a hospital may combine remote order verification at night with on-site review by day [2, 11]. Hybrid arrangements are practical, because they spread fixed costs and keep a physical base for emergencies, but they blur the boundaries used in regulation and research, and the data on them are correspondingly sparse [3, 16]. Terms like tele-verification, tele-counselling and tele-monitoring have been proposed to separate the functions, though usage is not yet consistent in the literature.

Home delivery and remote counselling for patients on long-term medicines form a smaller category that has grown quickly. Services typically combine a phone or video consultation with posted or couriered supplies, and they have been used for hospital-initiated treatments that are normally collected from the hospital [12, 13]. Their success relies on reliable delivery, secure handling of cold-chain items and consistent follow-up of adherence and adverse effects, which is more complicated than the consultation itself.

3. REPORTED OUTCOMES

Reported outcomes are collected in table 1 and grouped by service type in fig. 1. For rural remote dispensing the most important question is safety. Friesner and colleagues compared medication error rates in remote telepharmacies with those in traditional community pharmacies in North Dakota and found no higher rate in the remote sites [17]. Evaluation of the project also reported that communities regained access to pharmacy services that had been lost [5]. These results are reassuring, though they come from one programme with a particular regulatory design and may not extend elsewhere [3, 17].

Quality of medication use has also been examined. Pathak and colleagues compared rural areas with and without telepharmacy in the United States and reported that the presence of telepharmacy was associated with medication-use indicators that were comparable to those of other rural areas [18]. The study was observational and cannot show that telepharmacy caused the difference. Still, together with the error study, it argues against the worry that remote supervision lowers standards [17, 18]. Evidence from other health systems is much sparser and is often limited to descriptive accounts of service establishment [1, 6].

Table 1: Reported outcomes of telepharmacy by service type

Service and setting	Reported outcome	Ref.
Remote community pharmacy North Dakota	Pharmacy access restored in towns that had lost services	[5]
Remote versus conventional pharmacy Error rates	No higher medication error rate in remote sites	[17]
Rural telepharmacy Medication use quality	Medication-use indicators comparable to other rural areas, observational data	[18]
Multihospital system Remote order verification	Extended pharmacy coverage and lower cost reported	[11]
Hospital outpatients Pandemic service	Counselling and dispensing continued with reduced attendance	[12]
Ambulatory care Pharmacist telemedicine, narrative review	Generally favourable but heterogeneous outcomes	[14]
Ambulatory care Systematic review	Most studies improved clinical outcomes or processes; many small	[15]
Scoping review COVID-19 services	Counselling, refills and monitoring delivered remotely in many countries	[19]
User evaluation COVID-19 telepharmacy	Favourable user views; access to technology and training noted	[20]
Spanish hospital survey Outpatient telepharmacy	Rapid start or expansion of services within weeks	[13]

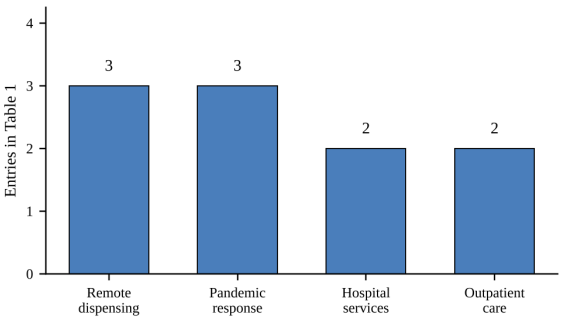


Fig. 1: Number of entries in table 1 by service type

Hospital telepharmacy outcomes have been reported mainly as process and economic

measures. Remote order verification extended hours of review, and reduced cost in the system described by Garrelts and colleagues [11]. Schneider's review of the impact of telepharmacy stressed that evaluations should capture clinical, economic and humanistic outcomes, since most published reports covered only one of the three [10]. Pharmacist interventions delivered in person have been shown to reduce cardiovascular risk in controlled trials, which supports the principle, if not the remote delivery, of such care [21].

Outpatient telepharmacy has the largest body of controlled evidence. A systematic review of clinical pharmacist services via telemedicine in ambulatory care found that most studies reported improved clinical outcomes or processes, such as blood pressure, glycated haemoglobin or adherence, but the studies were diverse and many were small [15]. Littauer and colleagues similarly described pharmacist-led care through telemedicine across conditions and concluded that results were generally favourable but heterogeneous [14]. Wider reviews of telemedicine for chronic disease reach comparable conclusions about benefit and variability [22, 23].

Medication adherence deserves its own mention, as it is a common endpoint. Remote counselling, reminders and refill coordination have been associated with better adherence in some studies, in line with broader evidence that technology-supported service delivery can modestly improve process measures [15, 23]. Effects are generally small and vary with the population and condition, and few studies follow adherence beyond a year. It is therefore prudent to regard adherence gains as plausible but not guaranteed, and to look for evidence in the same condition and setting before expecting similar results [14, 23].

Cost evidence is weaker still. A systematic review of cost-effectiveness studies of telemedicine found that few were of good quality, with most failing to include all relevant costs [24]. Pharmacist services in general are associated with savings in some settings, but the evidence for remote services in particular is thin [25]. Savings from avoided travel and extended coverage are plausible and are frequently claimed, while the costs of equipment, training, connectivity and maintenance are less often reported [10, 11].

A last point on interpretation: the same service can look different depending on the comparison chosen. Compared with no service at all, as in a town without a pharmacy, telepharmacy is plainly better, whereas compared with a well-staffed conventional pharmacy the gain is mainly convenience [5, 17]. Reviewers who pool studies with different comparators risk mixing these two questions, and readers should check which comparison was actually made before judging effectiveness [10, 15].

4. PANDEMIC EXPERIENCE

The COVID-19 pandemic changed telepharmacy from an option to a necessity in many places. Hospitals limited attendance to reduce infection risk, and pharmacists shifted to phone and video consultation, medicine delivery and remote verification [12, 26]. In Spain, a survey of hospital pharmacy departments found that many started or expanded telepharmacy for outpatients within weeks [13], and Margusino-Framiñán and colleagues described the structure of one such service [12]. The speed of change indicates that many of the barriers discussed below are not absolute and can be lowered quickly when the need is urgent.

A scoping review of telepharmacy in the pandemic identified services in many countries, including medication counselling, refill management, monitoring of chronic disease and support for patients with COVID-19 [19]. An evaluation of telepharmacy services in light of the pandemic reported favourable user views and described issues such as access to technology and the need for training [20]. General commentaries on telemedicine during COVID-19 argued that the emergency would lead to lasting changes in practice, while cautioning that unequal access could widen disparities [27, 28]. Outcomes were not routinely measured, so much of this literature describes activity and not effect.

What happens after the pandemic is uncertain. Some of the temporary arrangements, such as

relaxed rules on remote supervision and consultation, were introduced as emergency measures and may be withdrawn, while patients and staff who have used remote services may now expect them to remain [27, 28]. A sensible approach for services is to document what worked, collect outcome data while the arrangements are in place, and use these results in discussions with regulators about which flexibilities to keep [13, 19].

Community pharmacists also remained open throughout, and many literature accounts emphasise their role as accessible first contacts for advice about symptoms, vaccination and infection control, with remote tools supporting this work [26, 29, 30]. Hedima and colleagues, writing from Nigeria, described how pharmacists responded on the front line, and Al-Quteimat and Amer discussed how pharmacists could help during the outbreak, from counselling to reducing misinformation [29, 30]. These contributions are opinion and descriptive, not controlled studies, but they illustrate the breadth of tasks that can be handled at a distance.

Measurement of equity remains rudimentary. Few studies report who declined the service, who dropped out, or how outcomes differed by age, income, ethnicity or rurality, so it is hard to say whether telepharmacy narrows or widens gaps in care [27, 31]. Collecting even basic demographic data on users and non-users would allow such questions to be answered and would be inexpensive to add to routine service evaluation. Even short questionnaires at enrolment and exit would help to fill the gap.

5. IMPLEMENTATION BARRIERS

Regulation is the barrier most often named. In the United States, rules on remote supervision, technician qualifications, distance limits and licensure differ from state to state, and in many countries telepharmacy has no explicit legal basis [1, 2]. The professional statement of the American Society of Health-System Pharmacists sets out expectations for quality, privacy and accountability, but it cannot replace law [2]. Cross-border supply and the use of remote services by pharmacists registered in one jurisdiction and serving patients in another raise further questions that have received little attention [3, 8].

Technology and infrastructure come next. Reliable broadband, secure video platforms, integration with prescribing and dispensing systems and good image quality for verifying products are prerequisites, and rural areas are exactly where connectivity is weakest [1, 6]. Security and privacy of patient data are central concerns, particularly where commercial video tools are used, and compliance with data protection law is a continuing responsibility [3, 7]. Systems that fail at busy times or that duplicate data entry soon lose staff support, so human factors are as important as hardware.

Funding and workforce questions deserve more attention than they receive. A pharmacist who provides remote verification for several sites must be accredited and insured for each, and employers must decide whether time spent online counts as dispensing hours or as clinical service [2, 16]. Without a payment model that recognises remote clinical care, services depend on grants or on cross-subsidy from dispensing income, which makes them fragile [3, 25]. Workforce planners also need to consider whether remote work attracts pharmacists who would not otherwise relocate to rural areas, a claim made in policy documents but little tested [7, 8].

Professional and organisational barriers are also reported. Pharmacists worry about liability, loss of professional contact with patients and the difficulty of supervising a technician they cannot see, while technicians in remote sites carry more responsibility than their roles may have recognised [1, 5]. Workflow redesign is needed, and funding models in many systems pay for dispensed items and not for remote clinical services [3, 16]. Models of technology acceptance, such as the one proposed by Davis, suggest that perceived usefulness and ease of use largely determine whether staff adopt a tool, which matches the experience of services that grew after clear benefits were demonstrated [32].

Patient factors complete the list. Digital literacy, access to devices, language, disability and trust all influence who uses telepharmacy, and there is a risk that services

favour those already advantaged [3, 27]. Greenhalgh and colleagues developed a framework to explain why technologies that work in pilots are abandoned or fail to scale, pointing to the interaction of the condition, technology, value proposition, adopters, organisation, wider context and change over time [31]. Applying such a framework before launch can identify the weak points of a telepharmacy plan, and some services have done so informally by involving patients and staff in design [31, 32].

Quality assurance is a related matter. Remote services still require clear standards for documentation, identity checks, privacy, handover to a local professional and management of emergencies, and these have to be written in advance because a distant pharmacist cannot walk across the room to intervene [2, 16]. Audit systems for dispensing accuracy and adverse events are advisable and should cover both sites of the service.

6. PRACTICE IMPLICATIONS

For a service starting up, the literature suggests beginning with a clearly defined problem and a model that fits it. A rural dispensing service needs staff training, a camera-based verification process and agreed rules on the technician's tasks [5, 17]. A hospital service needs robust access to the electronic record and defined response times [11]. An outpatient consultation service benefits from integration with the prescriber, shared goals for each patient and a plan for those who cannot use video [14, 15]. Beginning small and measuring results from the start allows early fixes.

Outcome measurement should be planned from the beginning, using a mix of clinical, process, economic and patient-reported indicators, as Schneider suggested [10]. Safety indicators such as dispensing error and medication incidents are essential in remote dispensing, whereas blood pressure, glycaemic control or adherence suit chronic disease services [15, 17, 18]. Costs should include equipment, training and connectivity as well as pharmacist time, otherwise the economic case will be overstated [24, 25]. Without such data, services are difficult to defend when budgets are reviewed.

Training deserves emphasis. Pharmacists and technicians need skills in communication through a screen, in checking products by image, and in recognising when a case should be sent to a face-to-face service [1, 16]. Patient education about what the service can and cannot do prevents misunderstanding. Some professional bodies recommend that remote services be accompanied by access to a physical pharmacy for urgent needs, which can reassure patients and regulators alike [2, 8]. These practical points are modest, but their absence has been behind several failed pilots.

7. LIMITATIONS AND FUTURE DIRECTIONS

The evidence on telepharmacy has important weaknesses. Most studies are descriptive, uncontrolled or observational, follow-up is short, and many describe a single programme in one setting, which limits generalisation [1, 3, 10]. Outcomes are frequently process measures, such as number of consultations, and not clinical results. Publication bias probably favours successful services, and the pandemic literature is dominated by commentary and survey reports [19, 27]. Evidence from low- and middle-income countries is scarce, although these are the places where pharmacist shortages are greatest [7, 8].

Future research should therefore include controlled and pragmatic trials of remote services against usual care, with outcomes that matter to patients, and economic evaluations that count all costs [15, 22, 24]. Studies of equity, asking who uses and who is left out of telepharmacy, are needed [27, 31]. Regulators and professional bodies could harmonise requirements across regions so that services can be evaluated on comparable terms [2, 8]. If these gaps are addressed, telepharmacy can move from a promising adjunct to a well-evidenced component of pharmacy practice.

8. CONCLUSION

Published studies show that telepharmacy can take several forms, and that it works best when matched to a specific problem: lost

rural services, thin hospital coverage, or chronic disease review that clinics cannot staff. Reports of remote dispensing indicate that error rates and medication-use quality are comparable to those of conventional pharmacies, and outpatient services usually improve clinical measures [5, 15, 17, 18]. The pandemic accelerated adoption and showed that many barriers can be lowered rapidly when the need is clear [12, 13, 19].

Regulation, technology, funding, professional acceptance and patient access still decide whether a service succeeds [2, 31, 32]. Evidence is limited by uncontrolled designs, short follow-up and weak cost data [10, 24], and equity has received too little study [27]. For practice, services should start small, measure clinical, safety and cost outcomes from day one and plan for patients who cannot use video. For research, controlled evaluations and cross-jurisdiction harmonisation are the priorities [8, 15, 22].

9. ABBREVIATIONS

ASHP-American Society of Health-System Pharmacists, WHO-World Health Organization, COVID-19-Coronavirus disease 2019, HbA1c-Glycated haemoglobin, mHealth-Mobile health, NASSS-Non-adoption, abandonment, scale-up, spread and sustainability, TAM-Technology acceptance model, HIV-Human immunodeficiency virus

10. FUNDING

Nil

11. AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

12. CONFLICT OF INTERESTS

Declared none

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