SMGroup

Review of Research on Telepharmacy

Tim Stratton[1]*

[1]Department of Pharmacy Practice & Pharmaceutical Sciences, University of Minnesota, USA

*Corresponding author: Tim Stratton, Department of Pharmacy Practice & Pharmaceutical Sciences, University of Minnesota, USA, Tel: 218-726-6018; Fax: 218-726-6500; E-mail: tstratto@d.umn.edu

ABSTRACT

Telepharmacy is the use of telecommunications technology to provide pharmacist services to distant populations. Telepharmacy services may include drug review/monitoring, provision of drug information, medication dispensing, verification of oral and sterile compounding, patient assessment, patient counseling and medication therapy management. The implementation of telepharmacy systems is rapidly expanding due to the increasing affordability of videoconferencing technology and the increasing capability of the pharmacist to securely access electronic patient health records and perform traditional pharmacy practice activities remotely via the Internet. The number of scientifically-rigorous evaluations of telepharmacy has not kept pace with the rate of telepharmacy adoption. Donabedian recommends assessing the quality of health services by evaluating the structure, process and outcomes of services. Most telepharmacy reports in the literature are primarily descriptive, focusing mainly on the structure of the telepharmacy

service and describing how the service operates. Few studies report on the outcomes of these services, and fewer still are randomized, controlled trials. This article reviews studies of the outcomes of telepharmacy applications, focusing on evaluations of user satisfaction with telepharmacy services, on the impact of "after-hours" telepharmacy services on patient safety at remote hospitals, and on patients' clinical outcomes. The research on telepharmacy services reveals that patients are generally satisfied with the telepharmacy care they receive. Nurses and other healthcare professionals are also generally more satisfied with the after-hours pharmacy service they receive via telepharmacy than before the telepharmacy system was implemented. Telepharmacy services have generally been shown to improve medication-related patient safety at remote hospitals. Patient clinical outcomes have also shown improvement following the implementation of telepharmacy services. Recommendations for more stringent studies of telepharmacy services are provided.

Keywords: Telepharmacy; Telemedicine; Pharmacy; Pharmacies; Pharmacists; Medication therapy management; Drug information services

INTRODUCTION

Telehealth, Telemedicine and Telepharmacy

Telehealth has been defined as "the use of technology to deliver health care, health information or health education" to distant populations often living in medically underserved rural communities or those having problems accessing health care professionals and health care services [1]. Telehealth is intended to improve a patient's health by permitting two-way, real-time interactive communication between a patient and a healthcare provider who are geographically separated [2].

Telemedicine is oftentimes used interchangeably with telehealth. Telemedicine, however, more specifically describes the delivery of clinical services or clinical care to patients by a physician or other healthcare provider, whereas telehealth broadly describes all health-related uses of technology including clinical care, health education to professionals and patients, public health, research and administration [3].

Telepharmacy is the application of telehealth technology to pharmacy practice. The National Association of Boards of Pharmacy's (NABP) "Model State Pharmacy Act and Model Rules" defines the *Practice of Telepharmacy* as, "the provision of Pharmacist Care by registered Pharmacies and Pharmacists located within U.S. jurisdictions through the use of telecommunications or other technologies to patients or their agents at distances that are located within U.S. jurisdictions [4]." Elaborating on the NABP definition, a working definition of Telepharmacy proposed by the American Society of Health-System Pharmacists (ASHP) notes that Telepharmacy may include pharmacist activities such as drug review/monitoring, dispensing, verification of oral and sterile compounding, patient assessment, patient counseling and medication therapy management [5]. Medication Therapy Management (MTM), as defined in a consensus definition adopted by the

pharmacy profession in the United States in 2004, "is a service or group of services that optimize therapeutic outcomes for individual patients. [MTM] services include medication therapy reviews, pharmacotherapy consults, anticoagulation management, immunizations, health and wellness programs and many other clinical services. Pharmacists provide medication therapy management to help patients get the best benefits from their medications by actively managing drug therapy and by identifying, preventing and resolving medication-related problems." [6].

Telepharmacy Applications

Telepharmacy was born when a new invention, the telephone, was first installed in a pharmacy during the last quarter of the 19th century [7]. This earliest form of telepharmacy remains in wide use today, with pharmacists using the telephone to counsel patients about their medications or answer drug information questions for prescribers and other health professionals. Such interactions, however, usually occur when the pharmacist and other party are both located in the same community. For the purpose of this article, "telepharmacy" will be restricted to research involving communications technologies (including telephone, telefacsimile and videoconferencing) employed in pharmacy practice over distances that would make in-person interactions with the pharmacist impractical.

Telepharmacy has been utilized to expand access to pharmacist services for patients and other healthcare providers living in remote rural communities where no pharmacist is locally available, both in the United States [8-13], and elsewhere in the world [14-18]. Telepharmacy systems have been developed to facilitate medication order review, medication selection, and patient counseling in outpatient settings [8-10,15] and in hospital inpatient settings [12,13], to share expertise of critical care pharmacist specialists across intensive care units across several hospitals [19] and to remotely verify intravenous (IV) cancer chemotherapy [20,21].

Many reports of telepharmacy systems appearing in the lay press and peer-reviewed literature are primarily limited to descriptive accounts of how telepharmacy programs were planned and implemented, and how they operate [13,17,22-24]. Few articles report on the evaluation of actual outcomes of telepharmacy programs. The purpose of this article is to review the evaluative studies that do exist.

RESEARCH INVOLVING TELEPHARMACY

Donabedian's model for evaluating the quality of healthcare services addresses three components of healthcare provision: the structure to provide the care, the process involved in providing the care and the outcomes arising from the care provided [25]. While all three components of Donabedian's model have been applied to evaluate telepharmacy services, only research addressing the outcomes component of Donabedian's model will be addressed in the present article. Specifically, studies evaluating user satisfaction with telepharmacy services, the impact of telepharmacy services on medication-related patient safety and the impact of telepharmacy services on clinical outcomes will be reviewed.

Satisfaction with Telepharmacy Services

Phillips and colleagues [26] established telepharmacy videoconferencing via an encrypted digital subscriber line (DSL) connection between the Texas Tech University Health Sciences Center in Lubbock, Texas, and a rural clinic located 102 miles (163 Km) distant in Turkey, Texas. The remote clinic was staffed by an Emergency Medical Technician from 0800-1200 Monday through Friday, and medications at the clinic were stored in approved, secured blister packages. New and refill prescriptions were reviewed by a pharmacist at a central pharmacy located in urban Lubbock, but the prescription label and patient education monograph were printed at the remote clinic. The final prescription was approved by the pharmacist at the central site via store-and-forward video teleconferencing technology.

Patients at the remote clinic were surveyed regarding their satisfaction with the telepharmacy services. Overall, patients were very happy with the service. Virtually all patients surveyed indicated that they would have had to travel more than 40 miles (64 Km) to the nearest pharmacy to get their prescriptions filled had it not been for the telepharmacy option at the Turkey clinic. Similarly, virtually all patients surveyed indicated that they would rather see a pharmacist via the telepharmacy system than travel to see the pharmacist in person.

In 2001, the Community Health Association of Spokane (spoh CAN), a federally-qualified community health center in eastern Washington state, established a telepharmacy program with six urban and six rural clinics. The rural clinics were located as far as 104 miles (166 Km) away from Spokane [8]. The program allows medications to be dispensed to clinic patients via remote dispensing and counseling using a two-way interactive videoconferencing system. Over a two-week period in March 2003, 93 patients whose prescriptions were filled at remote telepharmacy sites and 106 patients whose prescriptions were filled at the base pharmacy site completed a satisfaction questionnaire about the pharmacy services they received. Among patients seen at the remote sites, over 75% were satisfied with their videoconference interactions with the pharmacist. At the base site, more than 65% of patients were satisfied with the time required to obtain medications and counseling. That is, 65% of patients receiving their prescriptions at the base pharmacy did not perceive that they had to wait an undo amount of time because the pharmacist was busy working with telepharmacy patients at the remote sites. These results suggest that the base pharmacy was able to provide satisfactory care to patients at the remote sites while not degrading the quality of care provided to patients at the base site.

Beginning in February, 2011, a pharmacist-led telemedicine service was launched by the Veterans Administration (VA) Health Center in West Los Angeles, California, to manage patients suffering from chronic hepatitis C infection [27]. The clinic used videoconferencing technology to conduct individual pharmacist-to-patient consultations, as well as pharmacist-led group education classes for patients who had hepatitis C. The hepatitis C telemedicine service was available at three remote sites (East Los Angeles; Bakersfield, California, 107 miles/171 Km from

the main site; and Santa Maria, California, 150 miles/240Km from the main site). A total of 96 patients were seen via the telemedicine service in the first nine months. A patient satisfaction survey was conducted at the end of 2011, with 18 questionnaires returned. Compared to patients who received in-person care at the main clinic in West Los Angeles, all telemedicine patients were at least equally satisfied with the care they received, and no remote site patients were dissatisfied with the telemedicine service. The telemedicine service reduced travel distance and the time it took for patients to attend their clinic appointment. Fully 82% of telemedicine patients who returned surveys preferred that their future hepatitis C clinic visits be conducted via telemedicine and 78% indicated that they would prefer any future clinic visit for any disease state management to be conducted via telemedicine.

Stratton and colleagues [12] evaluated the impact of an after-hours, remote pharmacy-order-entry (ARPOE) system between a tertiary care hub hospital in Duluth, Minnesota and eight geographically-remote critical access hospitals (CAHs) throughout the Arrowhead region of northeast Minnesota. Distances between the hub hospital and CAHs ranged from 23-128 miles (37-205 Km). "After hours" was defined as any time the CAH did not have a pharmacist at the hospital, generally evenings, weekends and holidays. During such times, pharmacists at the hub hospital would receive new medication orders by telefacsimile; review the patient's electronic medical record from the CAH in realtime over a secure internet connection to review relevant clinical laboratory values, the patient's current medications and patient medication allergies; and then release the ordered medication from an automated medication dispensing cabinet located at the CAH.

These researchers evaluated the impact of this telepharmacy service on nursing staff satisfaction with pharmacy services at their hospitals before and after implementation of the ARPOE system, as well as the impact that this telepharmacy system had on patient care at these small remote hospitals. The researchers found that nursing staff were more satisfied with the pharmacy services provided at their hospitals (overall, as well as after-hours) following implementation of telepharmacy system than before implementation.

To address a shortage of pharmacists within a health system in Kansas [28], telepharmacy services were established between four urban hospitals ranging in size from 40 to 410 beds and one 99-bed rural hospital. Seven pharmacists worked from their homes, utilizing computerized physician order entry and telepharmacy technology to review and verify medication orders and to release medications from automated medication storage cabinets located at the hospitals. Telephone calls from the participating hospitals were automatically routed to the telepharmacist on duty at the time so that calls would appear to be "transparent" to the hospital staffs.

The use of telepharmacists allowed onsite pharmacists at the study hospitals time to provide clinical pharmacy services (e.g., anticoagulation monitoring, medication reconciliation, etc.). The researchers conducted a pre- and post-telepharmacy implementation study to measure the impact of telepharmacy services on staffing and workload (i.e., pharmacist and nursing

satisfaction), clinical quality and patient safety (number of therapeutic interventions likely to have prevented a medication error/adverse drug event), and costs and cost savings/cost avoidance. Nurses' global satisfaction with pharmacist availability for consultations increased from 3/5 to 4/5 (p=0.028) while pharmacists' global job satisfaction was statistically similar before and after telepharmacy implementation.

Schneider [29] describes a telepharmacy service established for three community hospitals in northern California that lacked around-the-clock pharmacist services. Following implementation of the telepharmacy service, nurses' satisfaction survey scores reflecting comfort with the medication-use system, patient safety, and job satisfaction increased from 6.6 on a 10-point Likert-type scale to 7.3 ($p < 0.05$). Pharmacist scores on a similar satisfaction survey, however, dropped from 7.8 pre-implementation to 5.4 ($p < 0.05$). The authors do not address or otherwise speculate on this decrease in pharmacist survey scores following implementation of the telepharmacy service.

In a variation on the theme of satisfaction with telepharmacy services, Seifert et al. [30] assessed pharmacy student satisfaction with a telemedicine system as a training tool. This telemedicine system was already in place between a major university in Texas and seven rural Texas communities located 35-85 miles (55-135 Km) away from the university. The telemedicine system supports realtime video and audio clinical sessions between the physician and remote rural patients. The computer system also interfaces with instruments such as stethoscopes, pulse oximetry devices, otoscopes, thermometers, and electrocardiography devices to enable remote assessment of patients. The system is also used to introduce telepharmacy skills to senior pharmacy students participating in a required 6-week rural health clinical rotation.

The remote clinic sites are staffed by healthcare professionals such as emergency medical technicians (EMTs) or certified pharmacy technicians. At the time this study was described, students would spend one day per week with the physician operating the telemedicine equipment from the physician's office, three days with EMTs at different remote telemedicine sites, and one day working with the telepharmacist at the central pharmacy in the urban city where the university is located. The telepharmacist receives prescription orders electronically, performs drug utilization review activities, approves prescription labels generated at each remote site, and uses videoconferencing to counsel patients about proper use of their prescriptions. During this clinical experience, students document patients' disease states, patient medication histories, prescriptions filled through the telepharmacy, counseling via the telepharmacy system and any recommendations made to the patient. Students rated their experiences with the telemedicine/telepharmacy rotation. Of the 14 students completing this training experience at the time of the report, 75% indicated that they would recommend the telepharmacy rotation to future students.

Telepharmacy and Patient Safety

In 2002, researchers from the North Dakota State University College of Pharmacy, Nursing and Allied Health Sciences received a federal grant to establish a statewide telepharmacy program to save rural independent North Dakota pharmacies from closing as their owners retired and new graduate pharmacists were being lured to other states by higher salaries [31]. As the pharmacist was the only full-time healthcare professional in some of these rural communities, closure of the pharmacy would mean loss of local access to first-contact health care for residents of that community. In the North Dakota model, a registered pharmacy technician at a remote rural telepharmacy site processes prescriptions, supervised by a licensed pharmacist many miles away using videoconferencing technology. Pharmacists also counsel patients directly using this videoconferencing technology.

These researchers studied the occurrence of quality-related events (QREs): a prescription processing "error" that reached the patient, or a "near miss" that was caught by pharmacy staff before the prescription was delivered to the patient. QRE rates were compared across as many as 45 months at 14 telepharmacy sites and at 8 traditional pharmacies where the pharmacist was on-site. This study revealed that as a percentage of prescriptions filled at remote telepharmacy sites vs. traditional pharmacy sites, a statistically greater percentage of QREs occurred at telepharmacy sites throughout the study period. However, prescription error rates in both North Dakota groups were less than community pharmacy error rates reported nationally during the study period.

In the Minnesota rural hospital telepharmacy study already cited [12] the researchers reviewed and classified 700 after-hours clinical messages generated over the 20-month evaluation period by pharmacists at the hub hospital and transmitted to nursing staff or prescribers at the remote CAHs. Most of the clinical messages prevented a drug from being administered to a patient who had a contraindication to the drug or prevented an excessive dose of a drug from being administered to a patient. A limitation of this study was that no interprofessional expert panel was used to estimate the likelihood of patient harm occurring had these medications been administered as originally ordered [32].

In eastern Wisconsin, a health system that included 13 acute care hospitals (80 – 711 beds) spread across 14,000 square miles (22,400 Km) sought to provide around-the-clock clinical expertise of pharmacists trained in caring for critically ill patients in all of the health system's 246 intensive care unit (ICU) beds [19]. This health system's solution was to establish a "remote ICU" that was not attached to any of the hospitals, but rather was located in an independent facility in an urban area of the state. This remote ICU simultaneously monitors all critical care patients in different hospitals across the health system, and pharmacists are able to communicate with in-hospital ICU staff via videoconferencing. In this model, the 5.3 full-time-equivalent (FTE) pharmacists staffing the remote ICU also provide after-hours remote order entry services for the health system's seven smallest hospitals.

The only outcome systematically measured in this study was drug-related cost savings arising from the clinical consults for ICU patients. The authors note that additional measures might have included length of patient stay in the ICU, length of hospital stay, recovery time from infection, incidence of adverse drug events and ICU staff compliance with clinically-based quality indicators. Unfortunately, none of these outcomes were measured in this study. It was estimated that remote ICU pharmacist recommendations saved the health system an average of $1,340 per day, projected annually to $489,100. On-site ICU staff also reported anecdotally that use of the remote ICU pharmacists resulted in more timely communications and greater satisfaction than when ICU staff had to contact contract on-call pharmacists prior to implementation of the remote ICU model.

On a more national scale, telepharmacy initiatives in rural hospitals were identified through a survey of the 50 state offices of rural health [33]. In selected states which had successful telepharmacy programs in place, subsequent telephone interviews were conducted with board of pharmacy executive directors. Interviews were also conducted with the individual hospitals regarding the type of telepharmacy activities, funding, and impact of telepharmacy services on medication safety. Most hospitals reported that they tracked medication error rates, and some said error rates had improved since telepharmacy implementation. Unfortunately, this information is only anecdotal at best.

In Australia, a pharmacist at a hub hospital provided videoconference and other electronic telepharmacy services to nursing staff and patients at two rural hospitals which had no pharmacist on site. (Nurses at the rural hospitals took care of patients' pharmaceutical needs.) [16]. Following implementation of the telepharmacy services, statistically significant improvements were noted at the rural hospitals in the quality of medication history documentation, prevention of potential adverse drug reactions, appropriate duration of drug therapy and the quality of medication reconciliation at the time of patient discharge from the hospital.

Error rates in medication orders occurring at six small hospitals in rural or frontier counties in northern California were compared before and after implementation of after-hours telepharmacy consultation between nursing staff at the rural hospitals and a pharmacist at a 24/7 university hub hospital [34]. Rural hospitals were located 70-230 miles (112-370 Km) from the hub hospital. During the demonstration period, 82 after-hours medication orders that contained errors were caught and corrected by the remote pharmacist before the patient received the medication. Beyond this descriptive finding, however, the researchers do not report the number of errors that "slipped through" (reached the patient) after the telepharmacy service was implemented. This type of comparative measure has been used elsewhere, the "leak-through" error rate of pharmacists checking technician-filled medication orders being compared to the "leak-through" error rate from having a second pharmacy technician check technician-filled orders (the so-called "tech-check-tech" system) [35]. Therefore, it is difficult to ascertain from the California study what impact this telepharmacy system had on patient care.

The impact of potential adverse drug events from nurses overriding automated dispensing cabinets to administer high-risk medications before a pharmacist had a chance to review an order was studied in three community hospitals lacking 24-hour pharmacy services before and after the implementation of telepharmacy services [29]. High-risk medications were those listed as such by the Institute for Safe Medication Practices [36] as well as other medications selected by the researchers. Patient charts were reviewed for the following: prescribed therapy, dose documented as administered, indication, and medication-related problems such as claimed allergy to the drug administered, overdose/underdose, incorrect route of administration, drug interaction or no indication for drug. This study revealed that after implementation of the telepharmacy service, the number of times that nurses obtained and administered medications without pharmacist review declined by 35.3%. The percentage of high-risk medications obtained without a pharmacist review was significantly reduced from 9.6% to 8% ($p < 0.05\%$), and the number of medication errors detected via chart review dropped from 37 errors pre-telepharmacy implementation to 5 errors after implementation ($p = 0.0004$). There was also an increase in pharmacist interventions from 15 interventions prior to telepharmacy implementation to 98 per week post-implementation. Estimated cost savings resulting from the telepharmacists preventing, identifying, and resolving medication-related problems were $783,328 in total costs saved or avoided annually across the three hospitals, or $261,109 per hospital.

In the Kansas telepharmacy study already cited where seven pharmacists worked from their homes to provide telepharmacy services to four urban hospitals one rural hospital [28], the telepharmacy service was estimated to have resulted in savings to the health system. Much of these savings arise from freeing time for the on-site hospital pharmacists to provide more clinical services, optimizing the safe use of medications. These researchers estimated that savings of $21,772 accrued over one week ($1,132,144 annually).

Telepharmacy Clinical Outcomes

Asthma

Telepharmacy has been used in an attempt to improve the clinical outcomes of patients suffering from reactive airway disease (e.g., asthma). McLean and colleagues [37] undertook a Cochrane review of 21 clinical trials involving telehealthcare and asthma. Only two of the studies reviewed used pharmacists as the main deliverer of the telehealth intervention [38,39], and only one of these studies occurred across a great distance between pharmacists and patients [38]. This single study is summarized below.

In this early study of telepharmacy effectiveness, Bynum and colleagues [38] worked with 49 adolescent, predominantly African-American patients in rural southeast Arkansas who had a diagnosis of asthma and who were using multi-dose inhaler (MDI) medications. The patients were randomized to either a pharmacist-conducted training session about proper MDI use or to a usual-care control group who received written patient instructions and diagrams regarding proper MDI

technique (part of the U.S. Food and Drug Administration-approved package insert accompanying the medication). The young patients in both groups took part in the project from their local health clinics, interacting with the telepharmacists remotely via compressed videoconferencing. Both groups of patients participated in pre-education, post-education, and 2 to 4-week follow-up assessments for MDI technique and patient satisfaction (at the time of follow-up assessment only). Using pre-intervention/post-intervention assessments of patient MDI technique, patients in the experimental group received pharmacist-conducted training via compressed video during two 15-minute training sessions. In the usual-care control group, patients were provided the written patient instructions regarding proper MDI technique rather than pharmacist-conducted training regarding proper MDI technique. (Pharmacist counseling was provided at the end of the last study visit via compressed video to ensure that control group participants demonstrated proper technique at the end of the study.)

Of the 49 patients enrolled in the study, 36 completed the study. At baseline, MDI technique scores were not statistically different between the treatment and control groups. Immediately post-intervention and at 2-4 week follow-up, however, a greater percentage of patients in the telepharmacy counseling group performed the MDI technique correctly than patients in the control group (for each step of inhaler use, $p < 0.004$ or less). There was no significant difference between the telepharmacy counseling group and control group in satisfaction with the instructional sessions ($p = 0.132$).

An additional asthma-related telepharmacy study was published after the Cochrane review noted above [37]. This study involved 98 adult patients who had asthma and received their care through a regional healthcare system in predominantly rural north central Wisconsin, 86% of the population of this area living in either a medically-underserved area or health professional shortage area [40]. Over a three-month study period, patients in the usual care (control) group received mailed refills of their asthma medications and written patient instructions. Patients in the intervention group also received a monthly telephone call from the pharmacist who would review with the patient proper use of their asthma medications, contact the patient's primary healthcare provider if deemed clinically necessary, or refer the patient to a specialty provider, urgent care or emergency room if severe asthma-related problems were identified. During the call, pharmacists also assessed whether the patient needed additional education regarding inhaler technique. These researchers found no significant difference in Asthma Control Test scores between patients in the intervention group and the usual care group.

Diabetes Mellitus

Telepharmacy has also been used to try to improve clinical outcomes in patients suffering from diabetes mellitus. In a Veterans Administration (VA) program, a pharmacist-conducted Tele-MTM service resulted in significant improvements in surrogate outcomes markers for diabetes including HgbA1C, systolic blood pressure and low-density lipoprotein among 88 veterans

residing in rural communities within Veterans Integrated Service Network (VISN) 12 (Illinois, Wisconsin and the Upper Peninsula of Michigan) who received Tele-MTM services from VA Clinical Pharmacy Specialists [41]. Over a two-year period of Tele-MTM services among female veterans within this VA service area, the percentage of patients with an HgbA1c > 9% decreased by more than 5% at one telepharmacy receiver site and by 11.5% at a second rural telepharmacy receiver site.

Medication Adherence

Telepharmacy services have been employed to improve medication adherence (compliance) among patients. In the United Kingdom, a cost-effectiveness analysis was conducted using results from a randomized controlled trial of a telephone-based pharmacy advisory service to improve compliance with new prescriptions among elderly patients receiving four or more medications [42]. The intervention group consisted of 255 patients across the UK who received a phone call from a pharmacist two weeks after the patient had been recruited into the study. The pharmacist queried patients about how they were getting along with their medicines, enquired about any medication-related problems and adherence issues with their new medication, and whether the patient desired more information. These patients, as well as 237 patients in the control group were later contacted by a researcher (and again even later by survey) to query the patient regarding their adherence/non-adherence with their medications. The researchers compared incremental cost effectiveness ratios (ICERs) from the perspective of the UK's National Health Service, based on direct costs of providing the pharmacist intervention; payments to physicians for office visits and other outpatient costs; and payments for emergency room visits and hospitalizations.

A total of 87 patients from the intervention group and 118 patients from the control group completed the study and were used to conduct the cost effectiveness analysis. A greater percentage of patients in the intervention group (89%) were found to be adherent with their new prescription than patients in the control group (81%), $p < 0.05$. The ICER analysis determined the telepharmacist intervention to be dominant, being both more effective and resulting in fewer overall costs than the non-intervention group.

More recently, researchers from a pharmacy benefits management company in the United States studied the impact of telepharmacy videoconferencing consultation on medication adherence over a 13-month period among newly receiving specialty medications from a specialty pharmacy for treating hepatitis C, rheumatoid arthritis, multiple sclerosis or other conditions [43]. The 77 patients in the treatment group were compared to 1,465 patients also new to therapy during the same time period but who were not receiving care through the specialty pharmacy. Adherence was measured by evaluating the cumulative medication gap over 180 days following initiation of treatment, and odds ratios were calculated to determine the likelihood that a patient would be adherent with their medications at least 80% of the time over the 180 days. Patients receiving the videoconferencing session were found to be twice as likely to be adherent (OR=2.04; 95% CI, 1.02-4.07).

DISCUSSION

Telepharmacy has undergone a tremendous metamorphosis over the last 20 years with the increasing availability of videoconferencing technology and increasing capability to securely access electronic patient health records and perform traditional pharmacy practice activities remotely via the Internet. These technological advances are not without their critics, however. Nelson and colleagues [44] point out, for example, that the widespread use of live video to assess and correct inhaler technique for patients with asthma may be problematic due to connectivity issues and a lack of equipment in patients' homes. But in an unintended bit of irony, these researchers uncovered a major drawback in trying to teach proper inhaler technique using just a telephone between the pharmacist and the patient.

These researchers placed a pharmacist and participant in separate rooms connected by telephone. The pharmacist called the participant and asked the participant to use their inhaler. The participant's inhaler use was video-recorded, but not seen by the pharmacist. The participant was then asked to provide the pharmacist with a step-by-step explanation of how the participant used the inhaler. From the information verbally provided by the participant, the pharmacist documented the inhaler technique on a 10-point checklist, indicating which steps were correctly or incorrectly performed. (More correct/complete technique garnered higher scores.) A second pharmacist then visually evaluated the participant's inhaler technique by reviewing the video recording and using the same checklist to score the participant's initial inhaler technique. The mean initial MDI inhaler technique scores for the telephone and video methods of assessment were 7.2 ± 1.1 and 5.7 ± 1.6, respectively ($t=4.90$; $p<0.05$). These findings speak to the value of videoconferencing to allow the pharmacist to actually see the patient whenever possible.

Although the adoption of telepharmacy technology has increased rapidly in recent years, the scientific rigor of assessing outcomes from telepharmacy use has lagged somewhat. There are still very few controlled, randomized studies comparing patient's clinical outcomes arising via telepharmacy versus care provided in-person by the pharmacist. Many studies simply report descriptive process-related statistics (number of orders processed by the remote pharmacist, number and types of clinical messages transmitted from the remote pharmacist to on-site staff, etc.), but do not report on actual patient outcomes. Most studies that do attempt some type of quasi-experimental evaluation of outcomes rely only on a pre-post telepharmacy implementation design with a questionably-equivalent historical control.

Additionally, studies that have attempted to demonstrate that remote pharmacist review of orders prior to filling reduces potential adverse drug events [12,16,19,29,35] generally lack an interprofessional expert panel to estimate the likelihood that an adverse event would have occurred had the medication been administered as originally prescribed, or to assess the potential severity of that adverse drug event [32]. Furthermore, many studies could have been designed to measure more actual patient outcomes such as impact of telepharmacy services on adverse drug event rates, patient length of stay [19], and time to therapeutic goal.

CONCLUSIONS

Telepharmacy is an evolving patient care technology gaining more widespread use around the globe. The time is ripe for the scientific quality of evaluations of the impact of this technology on patient care to also evolve.

References

1. Health Resources and Services Administration. Telehealth. What is Telehealth.

2. Centers for Medicare & Medicaid Services (CMS). Telemedicine.

3. Health IT.gov What is telehealth? How is telehealth different from telemedicine?

4. National Association of Boards of Pharmacy (NABP) Model State Pharmacy Act and Model. Rules of the National Association of Boards of Pharmacy.

5. American Society of Health-System Pharmacists. Draft ASHP Statement on Telepharmacy.

6. American Pharmacists Association. APhA MTM Central.

7. PBS. American Experience: The Telephone.

8. Clifton GD, Byer H, Heaton K , Haberman DJ, Gill H. Provision of pharmacy services to underserved populations via remote dispensing and two-way videoconferencing. Am J Health Syst Pharm. 2003; 60: 2577–2582.

9. Peterson CD, Anderson HC. The North Dakota telepharmacy project: restoring and retaining pharmacy services in rural communities. J Pharm Technol. 2004; 20: 28-39.

10. Young D. Telepharmacy project aids North Dakota's rural communities. Am J Health-Syst Pharm. 2006; 63: 1776-1780.

11. Rose JL. Improved and expanded pharmacy care in rural Alaska through telepharmacy and alternative methods demonstration project. Int J Circumpolar Health. 2007; 66 (Suppl 1): 14-22.

12. Stratton TP, Worley MM, Schmidt M, Dudzik M. Implementing After-Hours Pharmacy Coverage for Critical Access Hospitals in Northeast Minnesota. Am J Health-Syst Pharm. 2008; 65: 1727-1734.

13. Wakefield DS, Ward MM, Loes JL O'Brien J, Sperry L. Implementation of a telepharmacy service to provide round-the-clock medication order review by pharmacists. Am J Health-Syst Pharm. 2010; 67: 2052-2057.

14. Moldenhauer ET. Remote checking of prescriptions in Navy health facilities. Am J Health-Syst Pharm. 2005; 62: 1866-1867.

15. Kimber MB and Peterson GM. Telepharmacy-enabling technology to provide quality pharmacy services in rural and remote communities. J Pharm Pract Res. 2006; 36: 128-133.

16. Poulson LK, Nissen L, Coombes I. Pharmaceutical review using telemedicine – a before and after feasibility study. Journal of Telemedicine and Telecare. 2010; 16: 95–99.

17. Traynor K. Navy takes telepharmacy worldwide. Am J Health-Syst Pharm. 2010; 67: 1134-1136.

18. Aung ZW. 2015; Telepharmacy: Time to pick up the line. Res in Social and Admin Sciences (Letter).

19. Meidl TM, Woller TW, Kglar AM, Brierton DG. Implementation of pharmacy services in a telemedicine intensive care unit. Am J Health-Syst Pharm. 2008; 65: 1464-1469.

20. Frellick M. Chemo telepharmacy project takes top award at ASHP. Medscape Pharmacists. 2014.

21. Erickson AK. Smilow expands the universe of cancer care with telepharmacy. Pharmacy Today. 2015.

22. Rilek RJ. Delivering medication therapy management services through telepharmacy to serve remote rural communities.

23. Peterson CD, Scott DM, Rathke, Killingsworth P, Hill G. Establishing a central order entry system for delivering telepharmacy services to remote rural hospitals. J Pharm Technol. 2010; 26: 179-186.

24. King LS. Remote pharmacy: it's closer than you think. The Pharmaceutical Journal. 2014.

25. Donabedian A. The quality of care: How can it be assessed? JAMA. 1988; 121: 1145–1150.

26. Phillips J Telepharmacy at Texas Tech.

27. You A, Kawamoto J, Smith JP. A pharmacist-managed telemedicine clinic for hepatitis C care: a descriptive analysis. J Telemed Telecare. 2014; 20: 99–101.

28. Garrelts JC, Gagnon M, Eisenberg C Moerer, Carrithers J. Impact of telepharmacy in a multihospital health system. Am J Health-Syst Pharm. 2010; 67: 1456-1462.

29. Schneider PJ. Evaluating the impact of telepharmacy. Am J Health Syst Pharm. 2013; 70: 2130–2135.

30. Seifert CF, Veronin MA, Kretschmer TD, McBeath DB, Stanford SJ, Turner D, et al. The Training of a Telepharmacist: Addressing the Needs of Rural West Texas. Am J Pharm Educ. 2004; 68.

31. Friesener DL, Scott DM, Rathke AM, Peterson CD, Anderson HC. Do remote community telepharmacies have higher medication error rates than traditional community pharmacies. Evidence from the North Dakota Telepharmacy Project. J Am Pharm Assoc. 2011; 51: 580–590.

32. Farley DO, Greenberg MD, Haviland AM, Lovejoy S. Prioritizing patient safety outcomes measures: results of an expert consensus process. RAND Patient Safety Evaluation Center. The RAND Corporation. 2008 (Jul). WR-601-AHRQ.

33. Casey MM, Sorensen TD, Elias W, Knudson A, Gregg W. Current practices and state regulations regarding telepharmacy in rural hospitals. Am J Health-Syst Pharm. 2010; 67: 1085-1092.

34. Cole SL, Grubbs JH, Din C, Nesbitt TS. (2012) Rural inpatient telepharmacy consultation demonstration for after-hours medication review. Telemedicine e-health.

35. Ness JE, Sullivan SD, Stergachis A. Accuracy of technicians and pharmacists in identifying dispensing errors. AJHP. 1994; 51: 354-357.

36. Institute for Safe Medication Practices.

37. McLean S, Chandler D, Nurmatov U, Liu J, Pagliari C, Car J, et al. Telehealthcare for asthma: A Cochrane review. CMAJ. 2010; 183: E733-742.

38. Bynum A, Hopkins D, Thomas A, Copeland N, Irwin C. The effect of telepharmacy counseling on metered-dose inhaler technique among adolescents with asthma in rural Arkansas. Telemedicine Journal e-Health. 2001; 7: 207-17.

39. Barbanel D, Eldridge S, Griffiths C. Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial. Thorax. 2003; 58: 851-854.

40. Young HN, Havican SN, Griesbach SA, Thorpe JM, Chewning BA, Sorkness CA. Patient and pharmacist telephonic encounters (PARTE) in an underserved rural population with asthma: Results of a pilot study. Telemed J E Health. 2012 Jul; 18: 427–433.

41. Calenda S, Levesque C, Groppi J, Kasimatis H, Leslie D. VHA seeks to expand telepharmacy's reach in 2014. U.S. Medicine. 2014.

42. Elliott RA, Barber N, Clifford C, Horne H, Hartley E. The cost effectiveness of a telephone-based pharmacy advisory service to improve adherence to newly prescribed medicines. Pharm World Sci. 2008; 30: 17-23.

43. Fensterheim LE, Gunn JG, Pokuta KL, Straszewski A, Marks A. Initial impact of telepharmacy on specialty medication adherence. Value in Health. 2015; 18: A299.

44. Nelson P, Young HN, Knobloch MJ, Griesbach SA. Telephonic monitoring and optimization of inhaler technique. Telemed J E Health. 2011; 17: 734–740.