Technology and Telemedicine in Hospital Pharmacy, It has Come to Stay

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ABSTRACT

In the area of Hospital Pharmacy, currently available technologies can be applied to the entire process of drug use, increasing efficiency, quality and safety. The great challenge at the present time to close the circle of safety is to ensure the traceability of the drug at all times, from its pharmaceutical compounding, distribution, storage, dispensing, processing and administration to the patient. This chapter will compile the technological advances that have allowed the hospital pharmacist to advance in his professional career, being the final beneficiary of all this process, the patient.

Keywords: Hospital Pharmacy; Technology; Advances; Telemedicine; Drug; Medicine; Dispensing; Storage; Administration; Monitoring

INTRODUCTION

In the last 20 years, there has been a significant advance in the development of technologies applied to the health field, which have allowed the development of integrated and shared information systems, through which we can have data on processes and results, and greatly reduce medical errors [1].

Various international and national organizations, such as Institute of Medicine, Institute for Safe Medication Practices, Joint Commission; National Patient Safety Foundation, American Health and Research, American Medical Informatics Association, National Quality Forum, Healthcare Information and Management Systems Society that health organizations have information systems that improve the quality, cost-effectiveness and safety in patient care [2,3].

The concept of m-Health, will allow a new form provision of health services or information relating to distance health to through mobile devices. It's a market fast growing which in 2017 will mean globally approximately 23€ billion [4]. In the area of Hospital Pharmacy, currently available technologies can be applied to the entire process of drug use, increasing efficiency, quality and safety. These are the software and hardware supports integrated with other databases of patient information at all levels of care, applied to the processes of drug use. The pharmacist's technical knowledge in information systems applied to the drug utilization circuit, and his active participation with other health and non-health professionals in this context, is key to making the most appropriate selection of technologies, estimating the value and contribution of each in the improvement of individual and collective health [5,6].

The introduction of new technological advances in Pharmacy Departments has allowed the acquisition of new tasks by hospital pharmacist. The discussion regarding the role of pharmacy technician and pharmacy support workforce roles is strongly influenced by the discussion on the pharmacist's role and the evolution of that discussion from a consideration of core pharmacy roles based within a dispensary, to a discussion of decentralized roles where pharmacists conduct more activities in patient-care areas [7,8].

Telemedicine includes both diagnosis and treatment, as well as health education. It is a technological resource that enables the optimization of health care services, saving time and money and facilitating access to distant areas to get specialist attention [9]. For this reason, this chapter will compile the technological advances that have allowed the hospital pharmacist to advance in his professional career, being the final beneficiary of all this process, the patient.

In the area of the drugs, technologies can be applied throughout the entire process of use of them, increasing efficiency, quality and safety. The pharmacist must be aware of the importance technical knowledge applied to the information systems and the use of drugs, in order to improve care of the patient and ensuring that new technologies lead to a more effective and safe use of the drugs. However, the great challenge at the present time to close the circle of safety is to ensure the traceability of the drug at all times, from its pharmaceutical compounding, distribution, storage, dispensing, processing and administration to the patient. This implies that each dose is unequivocally identified using the standardized code plus suitable [10].

It should be noted that this chapter focuses on the advances of the Hospital Pharmacy in development countries and in the progress of the clinical pharmacist in contact with the patients (Figure 1).

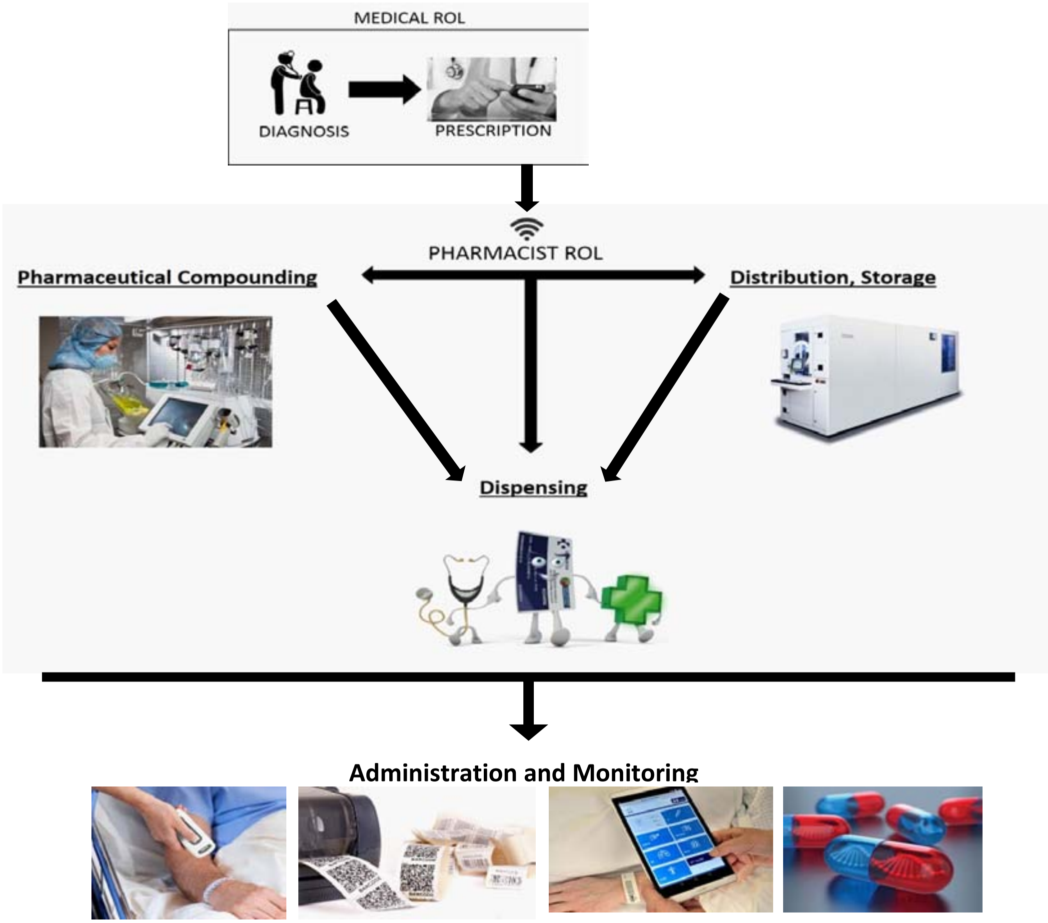

Figure 1: New advances and technology about traceability of the drug.

TELEPHARMACY AND COUNSELING/MONITORING

The National Association of Boards of Pharmacy defines the practice of Telepharmacy as the provision of pharmaceutical care through the use of telecommunications and information technologies to patients at a distance. There is no doubt about the fact that this takes a greater relevance in the ambulatory setting, because patients are far from healthcare providers. Pharmaceutical care in the ambulatory setting includes, but is not limited to, drug review and monitoring, dispensing of medications, medication therapy management, and patient counseling.

Telepharmacy programs applied to ambulatory care may have the following advantages above traditional pharmaceutical consultation:

- Cost-effectiveness. It might not be financially viable to support a full pharmacy in all rural areas. Thus, hiring a single pharmacist for multiple areas can save a lot of money.

- Avoidance of transportation difficulties and geographic barriers, minimizing travels and associated travel costs to both the patient and the health system.

- It allows a better understanding of the relationship of the patient with his medication. Pharmacists can obtain information from electronic records or frequent interviews with patients. As a result, they can adopt better decisions about the pharmacotherapy.

However, the implementation of these new technologies in the usual pharmaceutical practice is surrounded by some controversies:

- Exclusion of patients who do not handle these technologies (elderly patients or people with low socioeconomic status): applications should be as easy and intuitive as possible.

- Loss of contact with the patient: The pharmaceutical interview has a non-verbal communication component that is lost through telephone interview or via e-mail. It is recommended to make face-to-face visits at least at the beginning of treatment and annually, and when the patient ask for it.

- Costs: Telepharmacy can be long-term saving, but requires an initial outlay for the implementation of technology support.

- Confidentiality: Programs are needed to ensure the confidentiality of patient clinical information.

- Acceptability by patients and healthcare professionals: it is important to know the patients' preference when dealing with their healthcare providers. In this sense, many of the published studies carry a user satisfaction survey. There are published experiences that show a high level of user satisfaction and the non existence of significant differences in user satisfaction when comparing face-to-face pharmaceutical consultation versus teleconsultation [20-22]. However, we still have limited data about the impact of the implantation of those systems in the general assistance.

Published studies about the utility of telepharmacy and patient satisfaction have increased exponentially since 2014. The aim and the activities developed by pharmacists in those studies are diverse, according to the setting and illness treated. Telepharmacy programs have demonstrated a positive impact in the healthcare results of the patient attended in chronic pathologies as asthma [23], diabetes [24] or hypertension [25], improving the control of these patients with respect to the usual clinical practice. It has been made by monitoring clinical and analytic parameters like blood pressure or hemoglobin A1c and giving advice about changes in lifestyle and making adjustments in treatment according to agreed algorithms. Other experiences have not shown statistically significant differences in clinical variables, but have demonstrated non-inferiority compared to usual practice, which is also a favorable scenario attending to cost savings [20,22].

Remote Monitoring

Systems based on access to remote dispensing records, internet of things (**IoT**), consumer wearables, etc., are in continuous development. The IoT is a concept referring to networked everyday objects that interconnect to each other via wireless sensors attached to them. All these smart devices are promising tools that support personalization and monitoring and thus lead to better adherence and therapeutic results [26]. The process of medicines taking can be self-monitored or performed by the pharmacist using electronic devices. To enable personalized self-care, smart devices, consumer wearables, electronic pill boxes and applications should be designed to be easy to use with customizable features. These electronic devices could then concurrently support the goal of information gathering for healthcare decision support [27].

Remote Counseling

Very different models of telepharmacy have been developed in different institutions and different types of patients, designing tools for pharmaceutical-patient communication at a distance. These tools are based on the following strategies, being able to use only one or the combination of several:

- **Store and forward programs:** Systems in which the pharmaceutical-patient communication is asynchronous. These are, for example, systems based on electronic mail for sending queries between pharmacist and patient. They have the advantage of being able to attach images, sound or video recordings of high quality, etc (images of drugs, skin adverse events, instructions for intramuscular or subcutaneous drug administration, etc).

- **Interactive real-time programs:** Videoconference is one of the most versatile tools to deliver pharmaceutical care. It enables patient assessment, including nonverbal communication, and providing drug information support. It is widely used by Veterans Affairs clinics in highly rural areas of USA since 2014 [28]. Elderly patients often prefer to come to the clinic for face-to-face videoconference appointments, but they can be made from their home if they have a computer and access to internet. Visit duration is related to de object of the consultation and may vary if it is an initial visit or a follow-up appointment.

Another kind of synchronic real-time communication is phone calling. It allows patient to connect to a clinic or hospital from their home using their telephone lines. According to a national survey published in 2015, 35,5% of the hospitals in USA have programs in which pharmacists routinely provide either discharge medication counseling or post discharge follow-up through telephone calls to at-risk patient groups [29]. Also the use of videophones has been reported in a telepharmacy program involving mental health outpatients [30].

- **Combined programs:** Some telepharmacy projects have developed combined systems which have both advantages of the two mentioned before. One example is the one developed by the Clinic Hospital in Barcelona. It is called Virtual Hospital, and it is a web system designed for HIV patients attended at the area. It allows the participation of patients and health providers (physician, psychologist, nurse, psychiatrist, pharmacist, and social worker) as users [31]. Each patient must register with a user number, and have access to several areas in the Virtual Hospital and they have the possibility to perform medical and pharmaceutical consultations by video conference on a scheduled basis. Virtual Hospital also provides a telepharmacy service that controls treatment adherence and side effects, sending the medication to the patient's home by Courier (financed by the patient, etc.). A virtual community has been created, facilitating communication between patients. As a complement, there is a virtual library where users can find validated HIV/AIDS information helping to enhance prevention. The level of technical satisfaction with the virtual system was high: 85% of patients considered that Virtual Hospital improved their access to clinical data and they felt comfortable with the videoconference system. Nevertheless neither clinical parameters [level of CD4+ T lymphocytes, proportion of patients with an undetectable level of viral load and compliance levels >90%] nor the evaluation of quality of life or psychological questionnaires changed significantly between the new and the traditional type of care [20].

The type of data transmitted by the patient, the frequency of data transfer, (e.g. telephone, e-mail, SMS) and frequency of interactions between patient and pharmacist vary across studies, as do the type of healthcare system involved in delivering the intervention. The most common models of clinical pharmacy specialist support via telehealth are shown in (Figure 2).

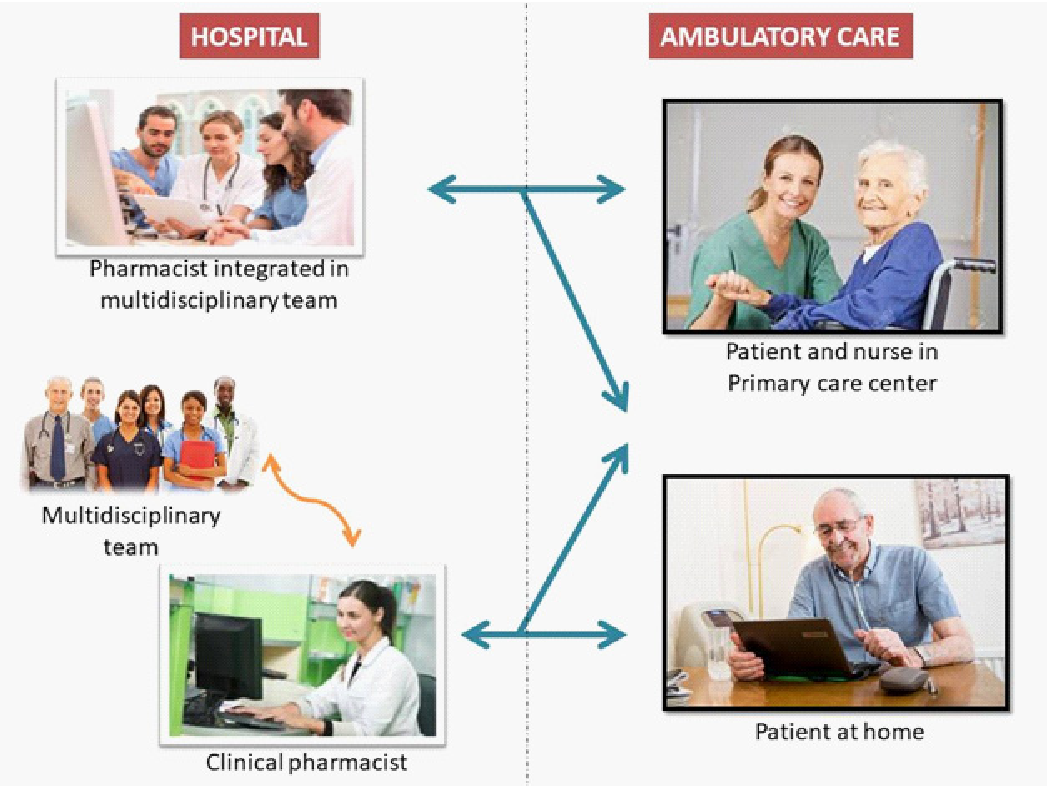

Figure 2: Models of clinical pharmacy specialist support via telehealth.

TELEPHARMACY AND SOCIAL MEDIA

Social media have transformed the way people communicate by reducing barriers to the exchange of information, increasing both the amount of communication and the number of people who can participate. Health care organizations (e.g., hospitals, health systems, professional societies, patient associations) have chosen to use social media for both communication and marketing. Also in the case of pharmacists: there are a big amount of twitter accounts of hospital pharmacy services, community pharmacies and clinical pharmacists.

One study conducted with pharmacists from nine countries revealed that the most used social media among consulted pharmacists were Wikipedia, Youtube and Facebook [32]. Most participants were community pharmacists. A posterior publication by the same authors stated that the pharmacists interviewed did not provide individualized services to consumers via social media, despite most of them working in a pharmacy with a Facebook page. They occasionally provided advice and general health information on social media to friends and followers, and more commonly corrected misleading health information spread on Facebook. Also short YouTube videos were used to support patient counseling in community pharmacy [33]. Twitter is the second most commonly used social media platform by hospitals in the United States and has been used by organizations to promote health and detect poor-quality health care [34]. American Society of Health System Pharmacists surveys suggested in 2013 that 25% of pharmacy students regularly used Twitter, 22% of new practitioners had an account, and only about 12% of pharmacists who were in practice kept an active Twitter account,14 compared with 13% of the general population [35].

The use of social media is increasing, and has significant potential as a health communication and educational tool, and may provide a medium for the delivery of health-related services. However, data about the impact of the interventions o education provided by pharmacists is still lacking and must be object of future research.

TELEPHARMACY AND DRUG DISTRIBUTION/STORAGE

One of the main problems that affect the hospital pharmacy today is related to the management of the drug supply chain. The purchase of drugs as well as the hospital's internal circuit (from its entry into the pharmacy service until its administration or dispensing to the patient) is a rather complex process which entails a high waste of time by the pharmacy staff. This complexity sometimes even leads to an increased risk of dispensing errors and medication administration errors [36-38]. In hospital pharmacy departments, there are many entry points for medicines (delivered by pharmaceutical laboratories, manufactured by the pharmacy service, returns from different medical units ...), as well as exit points (to a medical unit, to discharged patients, outpatients ...). In addition, the entry and exit drug flow occur simultaneously, therefore it make the drug supply chain an arduous process. These are the reasons why it is essential to design correctly the drug flow withinthe hospital.

Hospital pharmacy departments are becoming more automated. They are looking for an automation that simplifies all these processes, systems that allow us to make a more efficient management of drugs. But we also look for systems that allow the traceability of drugs from the time they arrive at the hospital until they are administered to the patient and thereby increase patient safety.

In recent years, Radio Frequency Identification (**RFID**) technology has slowly been added to pharmacy areas. Despite not being a novel technology, it can be very useful different areas of the health system.

RFID technology was invented in 1948. However, the adoption of large-scale RFID technology did not begin until the first decade of the 21st [39]. It's an object identification system using radio waves that allows us to have real-time information of our stored products. This technology uses tags attached to the objects to be identified through wireless communications.

There are three essential components in any RFID system: identification tags, the reader (with one or more antennas) and the software. The RFID working system is simple: The tags generate a radio frequency signal with the identification data. This signal can be captured by a reader which transmit it in digital format, to the software (Figure 3).

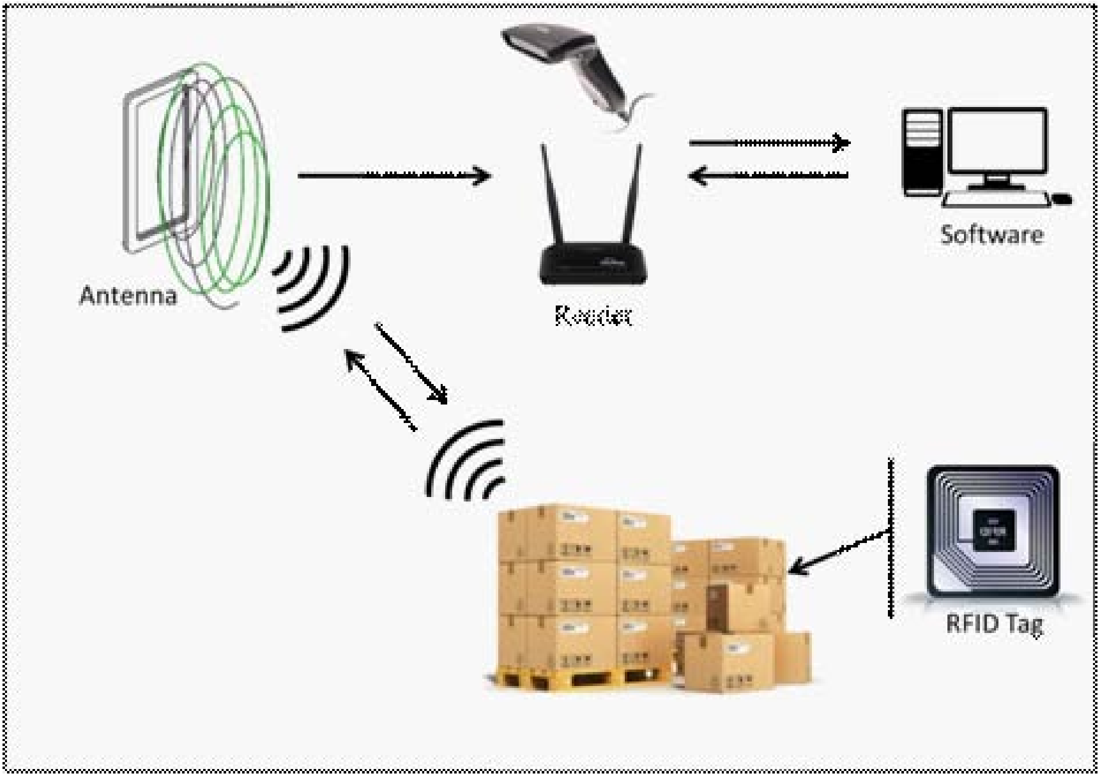

Figure 3: Basic RFID System flow.

There are different kind of tags we can use. Passive tags, semi-active tags and active tags. Passive tags do not require any internal power supply and are only activated when a reader is nearby to supply them with power. Semi-active and active tags need power, typically a small battery. The main differences between them are price, size, durability and distance range. We can see the differences between the three types in Table 1.

Table 1: RFID tags characteristics.

TAG	PASIVE	SEMI-ACTIVE	ACTIVE
Tag battery	No	Yes	Yes
Size	Small	Medium	Big
Communication Range	Short (Up to 10mts)	Long (Up to 100mts)	Long (Up to 100mts or more)
Prize	Less expensive	→	More expensive
Data Storage	Less	→	Higher
Tag expiration	Long life	Depends on battery	Depends on battery

We can classify RFID technology according to the radio waves used to communicate between system components. Most of RFID systems throughout the world operate in low frequency (**LF**), high frequency (**HF**), and ultra-high frequency (**UHF**) bands. There are important differences between them (Table 2). In logistics and in products management like medicines the frequency most used is the UHF because it is cheaper, faster, has higher range and greater storage capacity of information. The main problem of UHF in a pharmacy service is the interference that can produce both liquid and metallic products.

Table 2: Performance overview of most commonly RFID frequencies.

	LF	HF	UHF
Band	<135KHz	13.5MHz	433Mhz/860MHz/928MHz
Range	Low (10 cm)	Moderate	Moderate-High (1-100mts)
Data Speed	Low **<1kb/s**	Low-Moderate	Moderate-High **Up to 100kb/s**
Tag cost	High	←	Low
Tag size	Big	←	Small
Characteristics	Short range. Low data transfer rate. Penetrates water but not metal.	Higher rages. Resonable data transfer rate. Penetrates water but not metal.	Long rages. High data transfer rate. Cannot penetrate water or metal.

Applied to pharmacy services RFID technology has many advantages compared to the classical bar code. We can summarize the advantages in three points: Cost savings, product traceability and patient safety. Cost savings is perhaps a controversial affirmation. On one side this technology result in increases in personnel time saving, reduced out-of-stocks; minimized inventory losses, increased efficiency and productivity and with it the decrease in stock required [40]. So we can say that RFID tracking can increase efficiency and reduces costs related to management [39-41]. There are different experiences published like the one that occurred in California where after the hospital's implementation of RFID asset-tracking technology, the rate of lost and stolen devices decreased from 13.8 percent to none, resulting in annual cost savings of 200.000 $ [39] and in the Texas Health Harris Methodist Hospital Alliance in Fort Worth where in 2014 they could save about 65.000 $ per month [39]. On the other side it's true that the most important barriers to

RFID implementation in health system are costs and unclear ROI despite of the decreasing cost of the tags and associated equipment [40].

Safety and traceability are two terms that are linked. At least 44,000 people, and perhaps as many as 98,000 people, die in hospitals each year as a result of medical errors that could have been prevented [42]. As we have explained before, RFID technology is an object identification technology. It allows us to identify any utensils, medicines and even people. Apart from knowing how much medicine we have and where it is we can also know to whom it was administered. RFID can help us quickly identify patients and their corresponding medication (correct patient, correct medication, correct dosage, correct route of administration). So this technology greatly reduces medication and human errors [37,42,43].

It is also important to note that counterfeit drugs are a growing problem in the pharmaceutical supply chain worldwide. In 2009, 20 million pills, bottles and sachets of counterfeit and illegal medicines were seized in a five-month operation coordinated by the International Criminal Police Organization (Interpol) [44]. Barcode is easily counterfeited, whereas an RFID tag is almost impossible to counterfeit. An RFID tag contains an electronic product code, which is a unique identifier for each item or serial number (no two items are identical) [39]. Some pharmaceutical companies like Pfizer or Purdue Pharma L.P. have already incorporated RFID tags into their products, Viagra® and Oxycontin®, to combat counterfeiting [45].

Finally, it should be noted that although RFID technology seems to be an interesting technology, its implementation is slow and far from complete. The rate of implementation of RFID technology for stock management in US pharmacies tripled between 2008 and 2012. However, in 2012, only 1.5% of pharmacy services were available this technology [46]. 2D bar code is another identification system that, despite being more limited, it has been developed in the field of hospital pharmacy even more than RFID technology. [46]. The reason is probably because it is a cheaper technology but also much more limited. Differences between traditional barcodes, 2d bar codes an RFID are shown in Table 3.

Table 3: Comparison between common tag-based identification technologies.

Features Features	Traditional Bar codes	2D 2D BARCODE CODE 2D BARCODE	RFID
Direct line of sight requirement	Yes	Yes	No
Efficiency	Low	Even more limited than traditional bar codes, as the scan takes longer	High. Allows unattended identification. Multiple tags can be read in parallel
Difficult to duplicate or alter	No	No	Yes
Robustness (interference with liquids/metals)	No interference	No Interference	Yes
Cost of tags	Low	Low	High
Tag data storage	Very Low	Low	High

TELEPHARMACY AND DRUG DISPENSING

Joint commission assert that to improve drug safety, medical prescriptions must be reviewed by a pharmacist before drugs are dispensed and administered to patients. However, in many medical centers there is a shortage of staff and a pharmacist is not always available.

In the national survey conducted by the American Society of Health-System Pharmacist in 2015, it was observed that 42% of pharmacy departments open and staffed 24 hours, seven days a week. The 58% remaining is divided to "an affiliated hospital with 24-hour services" (16.8%), "a telepharmacy company provide afterhours medication order review and entry" (16.6%); "an employee pharmacist on call or at a remote location to provide these services"(11.2%), "orders were not reviewed by a pharmacist when the pharmacy department was closed" (13.8%) [47].

New technologies allow doctors to prescribe the treatment directly in a computer program with an electronic device (computer, PDA, Table PC) avoiding the transcription of the pharmacist. The pharmacist can review and verify the prescription remotely and authorize the dispensing of medication from a medication dispensing cabinet. Therefore, pharmacist can instantly verify prescribed drugs, dosage, route of administration, allergies, drug interactions and make recommendations if necessary. This obviously increases patient safety.

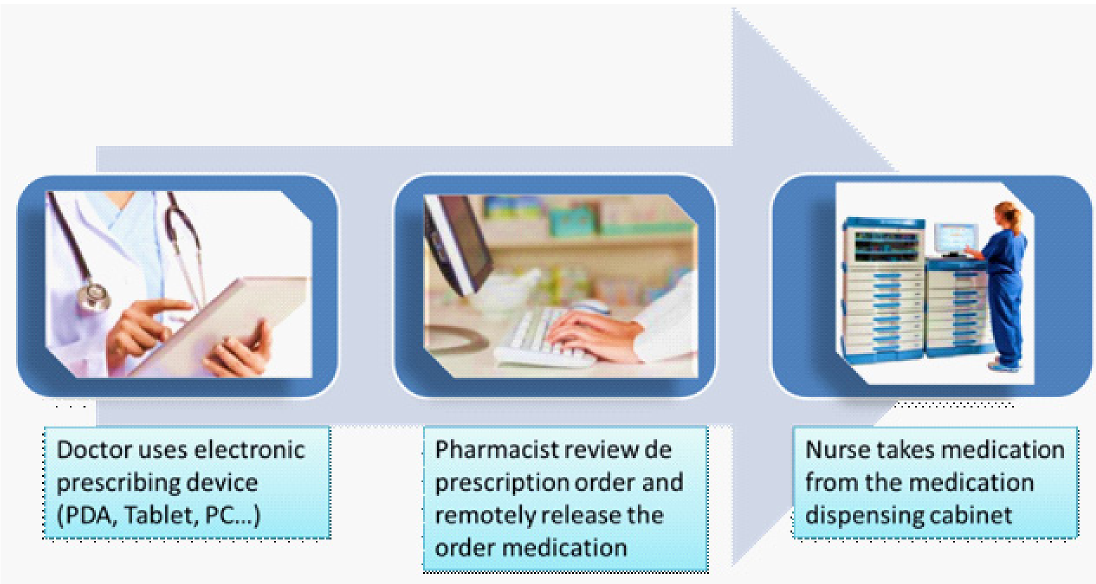

Figure 4: Telepharmacy workflow: Prescription, Checking, Dispensing.

It is obvious that one of the advantages of tele-pharmacy is to extend pharmacy coverage in hospitals that non-offer pharmacy services around the clock. The tele-pharmacy has been used successfully for this purpose. There have been published many articles of positive experiences in rural hospitals, nursing homes and in other medical centers without a 24h pharmaceutical coverage [48-51]. In a study evaluating the impact of tele-pharmacy in a community of three hospitals in California, they concluded that remote review of medication orders by pharmacists decreased the number of potential adverse drug events reported and improved job satisfaction among nurses. They also estimated that costs avoided by pharmacist's preventing, identifying, and resolving medication-related problems were 783,328$ annually for the three hospitals evaluated [52].

TELEPHARMACY AND PHARMACEUTICAL COMPOUNDING

Pharmacists are considered as scientists that efficiently contribute in the health care system and their role is related to the protection of the community health. They are involved into the manufacturing process, by formulating a drug into a medicine based on the good compounding practice guidelines [11,12]. The practice of pharmaceutical compounding dates back to the origins of pharmacy; yet, compounding presence throughout the pharmacy profession has changed over the years. In the 1930s, approximately 60 percent of all medications were compounded. During the 1950s and 60s, with the advent of manufacturing, compounding declined. The pharmacist's role as a preparer of medications quickly changed to that of a dispenser of manufactured dosage forms. In the 1990s physicians and patients again began realizing the benefits of preparing customized medications to meet specific patient needs [13].

The medicine depends on the technology, so that it cannot overcome the approaches and possibilities of this. We see in our daily practice the important advances in the development of a medicine, and more subsidiarity the concurrent need to provide a personalized pharmacotherapy [14]. The personalized elaboration of medicines has great relevance in classic areas such as pediatrics, dermatology or ophthalmology. The technology has been implemented in all areas of manufacturing, but mainly in the area of sterile preparations such as parenteral nutrition and chemotherapy [15].

This subsection of the chapter could be extended with the elaboration of a complete book in which new physical, technological and organizational models integrated in a modern pharmaceutical compounding area, nevertheless, we will focus on the more novel technological aspects. The technology in systems applied to the elaboration of medicines, has evolved much in the classical pharmaceutical compounding. However, it has developed exponentially in the preparation of high-risk drugs, either because of its greater complexity of elaboration or because of its intrinsic danger. The information contained in computer systems, or to which we can access with the new technologies is an efficient tool to improve patient safety. Electronic prescription systems integrated with the centralized unit of intravenous mixtures, other hospital databases and the drug management system improve the quality of care and information systems, increasing the efficiency of the resources used.

The automated pumping system compounds multiple sterile ingredients into a finished solution in a single patient bag. With these robots may help streamline your practice for compounding total parenteral nutrition and other multi-ingredient solutions. Designed for co-signer validation of right drug/right port, the once daily set-up includes a Prime and Verify process. Helps reduce the need for manual additions by pumping volumes as low as 0.2 mL. Produces a 3L patient-ready TPN bag in approximately four minutes, and facilitates compliance with detailed reporting on calibration activities, pumping accuracy and individual patient formulas [16,17].

Figure 5: Example of Automated Compounding Systems. (Exacta mix, Baxter®)

One area of special interest is the development of chemotherapy for onco-hematologic patients that requiring complex treatments. There are computer systems that can be performed in an Assisted, Safe and Efficient way in the processes of validation, conditioning and elaboration of antineoplastic and support treatments, maintenance of the guidelines established in Good Manufacturing Practices (**GMP**). A complete system is Farmis-Oncofarm®, this system allows simultaneous control of which additive (drug) and how much is added to a preparation ("parenteral mixture"), through controls by bar-code and optical sensors reinforced by the "Gravimetry". On the other hand, is managed intuitively with the help of a guide screen that assists the technician in the preparation and preparation of the treatments, and the pharmacist to monitor in real time, through tele-validation, all the steps that take place in the biological safety cabinet. Additionally, facilitates the control of the risk of occupational exposure of all professionals involved in the elaboration of "parenteral mixtures". Finally, these systems consist of a block destined to the generation of statistics (predefined or configurable) of high value for the continuous improvement of the quality of care and patient safety [18,19].

On the other hand, it should be pointed out that there is software that integrates tools for the creation and validation of pharmaceutical compounding, an example of such an application is PharmaSuite®, a new system created to integrally manage pharmaceutical compounding, guaranteeing the traceability of the whole process, from the raw material, to the validation and quality control of the finished product, with the ultimate goal of patient safety and efficacy - in compliance with the requirements and recommendations established by the health authorities.

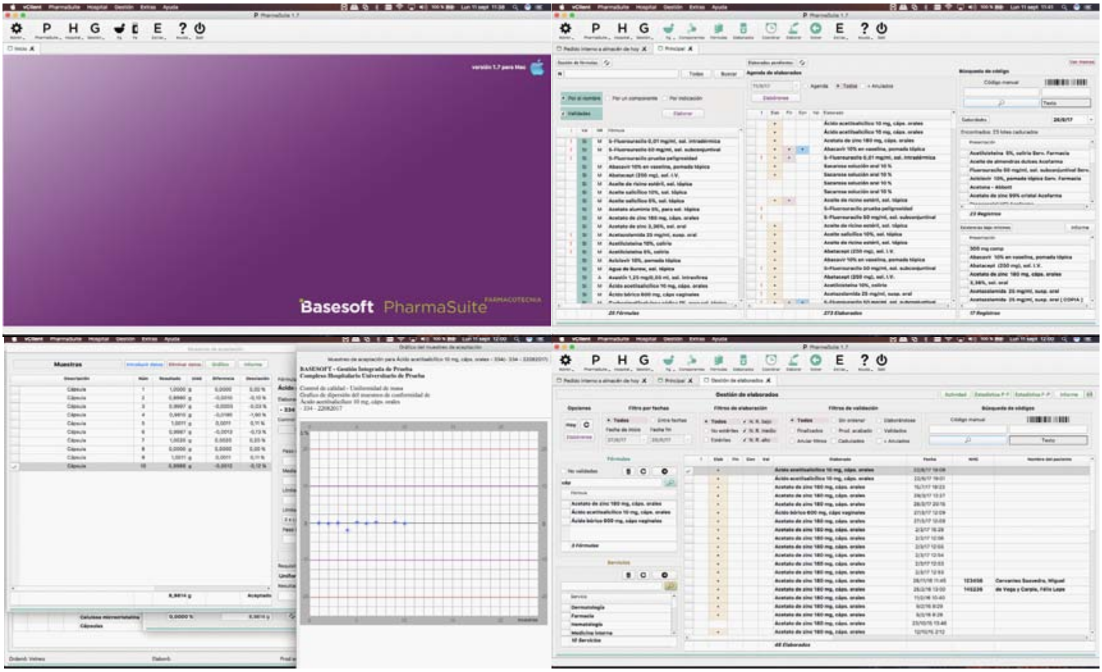

Figure 6: Software to pharmaceutical compounding. (Basesoft® PharmaSuite®).

PharmaSuite® allows the complete management of components, equipment, tools, processes, quality controls, human resources and patient information involved in the manufacturing process. This includes the identification and degree of responsibility of the healthcare personnel involved, batches and raw material, analysis bulletins, standard operating procedures, batches of preparations, patients, leaflets, prospectuses, barcode labeling/Data Matrix, programming and agenda for processing, integration with the Hospital Information System (**HIS**) and data exploitation. The use of PharmaSuite® guarantees the traceability and safety of preparations and is a valuable tool for implementing a compounding quality assurance system.

The workflow has changed since the implementation of PharmaSuite®, highlighting the creation and validation of formulas, including parenteral mixtures, integration of risk matrices from Guide to Good Drug Manufacturing Practices in Hospital Pharmacy Services, integration of dangerous drug lists from the National Institute for Safety and Hygiene at Work, programming of preparations from pre-loaded and validated standard operating procedures, automatic generation of documentation, signature with fingerprint and reduction in the use of paper. This application has made it possible to significantly improve the preparation and management of out-patient hospital treatments and the programming and control of master formulas for chronic patients. All of the preparations made by pharmacy departments (except for cytostatics) have been unified and automated, including pharmaceutical compounding and parenteral preparations, diagnostic tests and drug fractionation in the same database. Paper records were removed, and fingerprints have been introduced for access and the registrations of all users, as well as printing of labels for bar-coded preparations. This integration and recording of all process data, responsible personnel and processors allows the instantaneous retrieval of information for all preparations, as well as the patient's history.

The computerization of the entire process has allowed us to eliminate the errors that occurred with manual data recording and label printing. It has also enabled the thorough control and tracking of the shelf lives of raw materials and the assignment of validity periods to the processed preparations.

Telepharmacy applies telecommunications technology to optimize pharmaceutical care processes. These tools allow remote oversee of pharmaceutical compounding and stock management processes, which can be delegated. This way, pharmacists have more time for clinical or research activities. It also allows improving traceability and safety during the administration processes. In addition, it improves the communication with other healthcare professionals and patients at a distance, saving costs, expanding coverage, and increasing its capacity for clinical monitoring and adherence follow-up, which have already demonstrated impact on clinical outcomes in certain chronic pathologies.

Demonstration of potential benefits of these programs is challenging, because in many instances the technology might already be obsolete by the time the results are published. The future of telepharmacy goes through the development of increasingly interconnected systems that ensure the protection of clinical data while safeguarding confidentiality without increasing the cost of investment. Some problems, such as access to new technologies by certain sectors of the population, still have to be solved and certain reluctance by both patients and health professionals, who are wary of this physical distance from the patient. Despite of those difficulties, given the potential benefits, this technology has come here to stay.

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