



## Review Article

## The Assisted Electronic Prescription in Patients Hospitalised in a Chest Diseases Ward

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## ABSTRACT

Patient medical care requires a certain degree of individualized attention, and to this end technological support is becoming increasingly necessary, if not essential. Even so, the efforts directed at applying new technologies in the health-care system are not always sufficient, especially when taking into account that they could be key factors in patient safety.

Treatments are often prescribed manually, which could lead to errors due to ambiguity of the prescriptions, illegibility, calculation errors or transcription errors. The increasing sophistication of computer systems and programs used in the hospital care setting can be fundamental in reducing patient risk, detecting and correcting errors, contributing to making decisions by means of help applications and reducing costs in the long-term.

Polymedicated patients with common multiple diseases in medical specialty departments, such as Pulmonology, can particularly benefit from the application of these new technologies.

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### La prescripción electrónica asistida en pacientes hospitalizados en un servicio de Neumología

## RESUMEN

El cuidado médico de los enfermos precisa un grado de atención individualizada para el que cada vez son más necesarios, quizá imprescindibles, los soportes tecnológicos. Aún así, los esfuerzos dirigidos a aplicar nuevas tecnologías en el sistema sanitario no son siempre suficientes, teniendo en cuenta que pueden ser claves para la seguridad del paciente.

Con frecuencia los tratamientos se prescriben de forma manual, lo que puede ser causa de errores por ambigüedad de las prescripciones, ilegibilidad, errores de cálculo o errores de transcripción. La sofisticación cada vez mayor de los sistemas informáticos y programas aplicados al ámbito sanitario hospitalario puede ser fundamental en la reducción de riesgos para el paciente, detectando y corrigiendo errores, contribuyendo a la toma de decisiones mediante soportes de ayuda y reduciendo costes a largo plazo.

Los pacientes polimedicados y con múltiples enfermedades habituales en los servicios de especialidades médicas como Neumología pueden beneficiarse especialmente de la aplicación de estos avances tecnológicos.

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Progress made in the diagnosis of diseases and therapies have considerably increased the complexity of the health-care system. Patient medical care requires a degree of individualized attention, thus technological support is becoming more necessary, and even essential. However, the efforts made towards applying new technologies in the health-care system are not always sufficient when we take into account the fact that they are a key part in patient safety.

It is known that up to almost half of serious errors in medication are due to lack of patient and drug information.<sup>1</sup> Frequently, treatments are prescribed manually, which can be the cause of mistakes due to the ambiguity of the prescriptions, illegibility, and errors in calculation or in transcripción.<sup>2</sup>

Likewise, the increasing sophistication of software applications and programs, especially electronic prescription systems, applied in the hospital care setting can be fundamental in reducing patient risk by detecting and correcting errors, contributing to decision-making with help applications, and reducing long-term costs. The deficiencies in the communication amongst health-care professionals and the access to important patient data are weak points that need to be reinforced by new technologies.<sup>3</sup> Patients prescribed multiple medications for several common illnesses in specialized medical services, such as Pulmonology, can particularly benefit from the application of these technological advances.

### Electronic Prescriptions

Electronic prescription systems (EPS) have been demonstrated to be one of main tools for guaranteeing safety in one of the basic processes for the use of medications, which is the prescription. EPS are estimated to avoid up to 65% of errors in medicación.<sup>4</sup>

Computer applications for electronic prescriptions provide potential advantages, such as: a) almost immediate drug information (allergies, standard dosage, warning for maximum dose, interactions, treatment duration, adjustments in dosage in special clinical situations (renal insufficiency, hepatic insufficiency, etc.); b) improved communication among the health-care staff; c) links with other programs for improved patient management, which may result in safer treatment; d) patient confidentiality; e) alerts for the need to make a modification in the prescription; f) immediate information on the cost of the treatment;<sup>1</sup> g) different option fields for the physician to choose from, such as administration or dose. This latter characteristic of EPS has contributed the most to reducing the number of prescription errors.<sup>5</sup>

Furthermore, elements that are difficult to control, such as those due to omission, could be avoided at least in part by the suggestions associated with other prescription fields. For example, when recommending care such as bed rest, the program can make an associated recommendation of thromboembolic prophylaxis in patients at risk. Or, when prescribing drugs that require monitoring, such as gentamicin or vancomycin, it can suggest the determination of the patient's plasma levels. Overchase et al.<sup>6</sup> found that suggestions like these were accepted and generated changes in the prescription in 46% of cases, compared with 22% in their control group. However, it is known that many alerts go unnoticed and that an excessive number of suggestions can be counterproductive.

Software applications can also decrease mistakes in calculation due to human error that can frequently have serious repercussions in patients.

Nevertheless, the financial investment involved in implementing these systems, the lack of system standardization and the incompatibility among systems, even within the same institution, are important impediments for their implementation. Moreover, there is a certain tendency amongst health-care workers to see these tools as not very useful, and when an error arises they feel the system is to blame. Likewise, there is a general mistrust of new technologies

regarding privacy and legal issues.<sup>7</sup> It is also clear that change and learning new skills also generate a certain amount of rejection.

A recent meta-analysis included the studies involving electronic prescriptions in hospitalized patients up until 2007.<sup>8</sup> These were divided into six categories, depending on the results: adherence to clinical guidelines, treatment safety, efficiency, alerts, satisfaction and utility. The main conclusions of the paper were: electronic prescriptions have been shown to reduce errors in medication, although they do not reduce the adverse effects of medicines; they are especially useful for adhering to relevant recommendations and alerts, although on several occasions these were obviated by the clinicians. An increase in time dedicated to the prescription process by the physicians was also detected, but it was shortened in the rest of the therapeutic drug process. *As for the patients seen in outpatient consultations, electronic prescriptions are being applied with advantages, although we must not forget the possible disadvantages such as the limited amount of time that doctors spend with each patient, which may make this system difficult to learn and complicated to implement. This is even more so among older, polymedicated patients, as occurs in many patients with respiratory diseases.*

EPS has been demonstrated to be especially useful in reducing errors in medication due to mistakes in the prescription of widely-used drugs in the treatment of respiratory diseases, such as antimicrobial agents, improving the quality of the prescription of the same, reducing errors in prescription, hospital stay and costs<sup>9</sup> or antineoplastic drugs.<sup>10</sup> We have found no data referring to the utility of this technology specifically in respiratory patients.

Despite all this evidence about the advantages derived from electronic prescriptions, the use of new technologies in the health-care setting is far behind its application in private industry. In our country, the introduction of these prescription methods in hospitals started at the beginning of the last decade. The Spanish Society of Hospital Pharmacy has established a plan of action whose objective is that in 2020 this prescription system will be introduced in 80% of hospitals.<sup>3</sup>

But it is important to know the relevance of the problem of hospitalized patient safety, as the investment in new technologies has a high financial cost and requires adaptation of the health-care staff. In this regard, several studies have been published. *In the United States, three studies carried out in the 1990's helped make people aware of the magnitude of the problem. In the Harvard Medical Practice Study on the incidence and types of adverse events caused by medical intervention, it was found that 3.7% of hospitalized patients had suffered events derived from pharmacological intervention during their hospital stay: 19.4% were caused by medication and 45% were considered preventable.<sup>11,12</sup> The ADE Prevention Study, a prospective study done at Brigham and Women's Hospital and Massachusetts General Hospital in Boston, showed that 6.5% of hospitalized patients had suffered an adverse event due to medicines during their hospitalization and approximately 28% of these were a consequence of errors in medication.<sup>2</sup> In addition, the financial cost was evaluated, and it was estimated that each adverse event increased the mean cost of the hospital stay by \$4,700.*

The report *To err is human*,<sup>13</sup> published in 1999 by the Committee on Quality of Health Care in America from the Institute of Medicine (IOM), reported that medical errors caused between 44,000 and 98,000 deaths a year in the US. As a result of this publication, health-care officials started to develop measures aimed at reducing these errors. Among these, an essential part in the prevention of medical errors is the so-called CPOE (computerized physician order entry) which in Spain is called *prescripción médica electrónica* (electronic medical prescription). The most recent data have reported that some 7,000 annual deaths in the USA occur due errors in medication.<sup>14</sup>

In Spain in 2005, the first protocol was carried out on the adverse effects of hospital care and attention, the ENEAS study.<sup>15</sup> Twenty-four Spanish public hospitals participated, reviewing 5,755 clinical histories of patients admitted. The results indicated that 9.3% of the

patients admitted had an adverse effect directly related with hospital care. The main cause of adverse effects, according to this study, was related to the use of medicine (37.4%), hospital infections (25.3%) and surgical procedures (25%). Moreover it was estimated that 42.8% were avoidable.<sup>8</sup> In addition, the Quality Agency of the Spanish Ministry for Social Health and Policy, in collaboration with ISMP-Spain (Spanish delegation of the Institute for Safe Medication Practices), has promoted a recently-published study evaluating the safety of medicines<sup>16</sup> that has made an analysis of the situation regarding the implementation of safe practices for the use of medication in Spanish hospitals. This paper was able to identify weak spots in the system of the use of medicine, such as the lack of staff training (22.4%), deficient patient information registered (age, weight, allergies, previous diagnoses and treatments) and lack of coordination between the different health-care levels for sharing patient data, while stressing the need for adequate training, risk management, the incorporation of new technologies and active patient participation. It has been confirmed that the majority of the clinically-relevant prescription errors are concentrated in three drug groups: anti-infectives (fundamental drugs in the treatment of respiratory disease), cardiovascular agents and opiate analgesics.<sup>4</sup>

According to different authors,<sup>17,18</sup> errors in dose of medication are preventable errors that can more frequently give rise to adverse events and are responsible for a third of clinically-relevant adverse events.<sup>19</sup> Another important group of prescription errors can be attributed to deficiencies in the understanding of drugs. In fact, treatments are becoming more and more complex; more drugs are being prescribed and the age of hospitalized patients has increased notably.

### Prescribing Drugs in Hospitalized Pulmonology Patients

In the last few years, the importance of respiratory diseases has increased markedly, generating a high number of hospitalizations.

Chronic obstructive pulmonary disease (COPD) and pneumonia are perhaps the main diseases involved in patients hospitalizations in the Pulmonology Unit. COPD affects 15% of the world-wide population and more than 1.5 million Spaniards and is the third most frequent diagnosis on hospital discharge reports. This is basically due to the fact that there are currently more people smoking than at any other moment in the history of humanity. In our country, the mean age at which Spaniards start smoking is at 13.1 years, and daily cigarette consumption becomes established at 14.2 years of age.<sup>20</sup> The annual death rate for this disease is 60 deaths per 100,000 inhabitants among men (fifth most common cause of death) and 14 per 100,000 inhabitants in women (seventh most common cause of death).<sup>21,22</sup> The World Health Organization (WHO) considers that in 2030 COPD will be the third cause of death,<sup>23</sup> and, according to the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR) in 1998, the health-care and social cost of COPD equaled 2% of the budget of the Spanish public health-care system; in other words, 0.25% of the gross domestic product (GDP).<sup>24,25</sup>

The suppression of tobacco use is a cost-efficient intervention and is the main measure for avoiding the development and progression of COPD.<sup>26</sup> As for COPD pharmacological management, it is mainly made up of bronchodilator agents, among which the most often prescribed for treatment in stable phase are  $\beta_2$  adrenergic agonists and anticholinergics. The latest GOLD guidelines<sup>27</sup> have introduced a new recommendation for selecting treatment with short-acting bronchodilators for patients with stable symptomatic COPD and, for those who have at least two COPD exacerbations each year, long-acting bronchodilators, including both anticholinergics (tiotropium bromide) as well as  $\beta_2$  agonists (formoterol, salmeterol). These inhaled drugs are often difficult for the patients to manage, and it is therefore recommended to use the same inhaler throughout the health-care process in order to avoid mistakes. As previously

mentioned, the fact that the EPS helps reconcile the medication upon hospital admittance or discharge can facilitate the management of these inhaled drugs.

Likewise, pneumonia constitutes another of the most frequent diagnoses in patients hospitalized in Pulmonology Units. This is true for both infections that are the motivation for hospitalization, or community-acquired pneumonia (CAP) (less than 10% of cases), as well as for pneumonia that presents in previously-hospitalized patients, or nosocomial pneumonia. *The etiological diagnosis of patients hospitalized for CAP ranges between 40 and 60%; S. pneumoniae is the predominant pathogen.*<sup>28</sup> For this disease, the main type of drugs used, in importance and in cost, is antimicrobial. As mentioned before, they constitute one of the therapeutic groups that are most frequently implicated in prescription errors.

The choice of antibiotic treatment should be based on microbiologic findings, but as this is not possible in the majority of cases, the decision has to be based on clinical manifestations, epidemiologic factors and prevalent resistances in each geographic area. In any case, empiric treatment should be adjusted, in theory, to the microbiological results when these are available.

If there is an area where EPS has a clear indication, it is in the management of high-risk drugs such as antineoplastic protocols, specifically and within the specialty of Pulmonology, in lung cancer, with its high prevalence and severity.

This type of cancer currently represents, in developed countries, the second ranked cause of death after cardiovascular diseases. Among tumors, it is the first cause of death in men and the fourth in women, with a clearly growing trend. The mortality rate in Spain in 2002 was 49.2 per 100,000 inhabitants in men and 4.7 per 100,000 inhabitants in women, while in 80% of cases, smoking is the main risk factor.<sup>29</sup>

The treatment of this disease implies the utilization of antineoplastic drugs (derived mainly from platinum, taxanes and etoposide). They are considered "high-risk medications", meaning they have a very high risk for causing severe or even mortal damage when an error occurs in the course of their use. This concept does not indicate that the errors associated with these drugs are more frequent, but instead, in the event of an error, the consequences for the patients are usually more severe.<sup>30</sup>

In chemotherapy, an error in medication means any potential or real error in which the antineoplastics or the adjuvant medication is prescribed, transcribed, prepared, dispensed or administered at a dose that is not appropriate for the patient, on a mistaken date and/or using an incorrect administration technique, including the vehicle, duration, velocity, concentration, compatibility and stability, order of administration or the involuntary omission of a medicine in the prescription.<sup>31</sup>

There are numerous factors related with antineoplastic treatments that may lead to the appearance of errors:

- Narrow therapeutic margin
- Need to individualize the dosage depending on the body surface, indication or method of administration.
- Complex therapeutic models with combinations of different antineoplastic drugs.
- Individualization of dosage and number of cycles depending on the clinical situation of the patient.
- High-risk drugs deriving potentially severe errors in medication.
- Coexistence of research protocols with standard chemotherapy models.

The most frequent causes of these errors mainly have to do with prescriptions with imprecise denominations, incorrect dosage or duration, incorrect administration, lack of allergies registered, confusion of chemotherapy and alteration in the sequence of administration of the different antineoplastic agents.

Medications that are considered high risk must be made a priority objective in all clinical safety programs established in hospitals. In doing so, the safety in managing these antineoplastic drugs requires adopting measures directed at minimizing risks, through proactive intervention that allows for early detection of the error in the different phases of prescription, preparation and administration. *Computerized prescriptions have been shown to reduce errors in prescribing antineoplastics, making it easier to calculate prescriptions with help applications and the inclusion of alarms.*<sup>32</sup>

Nevertheless, there is no single practice that alone can guarantee safety in using high-risk medication. It is instead necessary to introduce different methods in each and every of the stages that make up the system of medicine utilization. Therefore, it is recommended to introduce specific practices directed at avoiding errors in packaging, labeling, storage, prescription, dispensation, preparation and administration of antineoplastic drugs. In this regard, some programs have a security system not only in the prescription phase of treatments, but also incorporating new technologies that reduce errors by computer systems used for administration, such as bar code systems and the control of drug infusions by means of "intelligent pumps". These are able to identify the chemotherapy with the corresponding patient, the correct sequence and the proper duration and administration.

The use of bar codes is very widespread and it is a validated, low-cost system that is user-friendly. It is a good technology for the identification of medications, as they are individually identified in the pharmaceutical industry by this system. If not, the hospitals themselves would have to do the labeling. Another technology that is even more advanced than bar codes applies radiofrequency microchips, which are able to send a signal at a distance to communicate with the server, without the need for manually using the optical reader. Unfortunately, the cost of this system is still high.

Lastly, it is important to mention the intelligent infusion pumps. It is a technology that has demonstrated a reduction in errors associated with the administration of medicines. These pumps come with safety software in order to include different treatments in a protocol. Its features include programming alarm levels with pre-established limits for the dose of medicines, speed of dosage and concentration of the medicines.

Despite the advantages provided by new technologies, especially in patients undergoing treatment with high-risk drugs, the degree of implementation of the best-known methods for preventing errors with high-risk medication in Spanish hospitals is very low. This data was deduced from the latest self-evaluation survey about the safety of the system for medicine use in hospitals, adapted from the ISMP (Institute for Safe Medication Practices) by the ISMP-Spain.<sup>18</sup>

After everything we have mentioned, the level of EPS-use in our setting is still limited, probably due to the deep changes entailed in its establishment in hospitals. It is important to first be conscious of the importance of the errors in medication and their high frequency, particularly in complex diseases such as diseases of the respiratory apparatus, and direct strategies towards greater patient safety in order for health-care personnel as a whole to accept the need for the use of new technologies such as EPS.

According to recent data,<sup>33</sup> only 17% of the hospitals members of the *American Hospital Association* have EPS. In Spain, according to the latest survey of the Spanish Society of Hospital Pharmacy, 22.7% of centers use EPS, although these data may not be very representative given the limited level of participation of the centers (38.6%).<sup>34</sup> After carrying out a review of the literature in *PubMed*, we have found no specific data about its use in Pulmonology. Although the articles published on EPS in Spanish hospitals are numerous, we have only detected one in the bibliography reviewed where a specific reference is made to the specialty of Pulmonology, according to which the error rate was reduced from 25 to 4%.<sup>35</sup>

Prescribing drugs in pulmonology is a complex process that is becoming more and more expensive due to the fact that respiratory patients are frequently polymedicated, have comorbidities and are of advanced ages. In some cases, high-risk medicines are used, which complicate clinical management even more. These factors are often the cause of error in the prescription of drugs and undesired effects that affect the safety of the patient and the quality of health care.

New computer applications, mainly EPS for medications, are shown to be a useful tool, not only in the improvement in patient safety, but also in the efficiency of therapeutic drug process.

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