



ORIGINAL ARTICLE

Electronically assisted prescription will minimise drug transcription errors

S.E. García-Ramos,* G. Baldominos Utrilla

Servicio de Farmacia, Hospital Universitario Príncipe de Asturias, Alcalá de Henares, Madrid, Spain

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KEYWORDS

Medication errors;
Administration errors;
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Abstract

Objective: To assess the impact of administration errors when transcribing treatments to nurses' administration forms, and to estimate the impact of electronically assisted prescription (EAP) in minimising these errors.

Method: A prospective, observational study in hospitalised patients. In a representative sample changes in treatment in the 24 h before the examination are analysed. Transcription errors were detected when checking the discrepancies between the medical prescription and the nurses' treatment administration forms. Error incidence was calculated as a whole and by ward, type of error, administration route and their potential danger. The possible reduction in new errors per day if the EAP were to be introduced in all units was estimated.

Results: Of the 416 prescriptions recorded, the overall percentage of transcription errors was 12.4%, 9.8% in medical units and 15.2% in surgical units. Most of the errors were made when a new medicine was added (29.4%) and the frequency of administration was changed (27.4%). With regard to their gravity, 98% did not harm the patients, and 57.7% were filed as "Category C". Taking into account that 1 change of treatment is made per patient per day, the introduction of the EAP is predicted to prevent 64 new errors daily in the hospital.

Conclusions: There are so many transcription errors that they should be taken into account when designing strategies to improve care quality. EAP is an efficient tool to eliminate errors associated with the transcription of prescriptions.

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PALABRAS CLAVE

Errores de
medicación;
Errores de
administración;
Errores de
transcripción;

Impacto de la prescripción electrónica asistida en la reducción de los errores de transcripción a la hoja de administración

Resumen

Objetivo: Evaluar la incidencia de errores de administración por transcripción errónea a la hoja de administración de enfermería y estimar el impacto de la prescripción electrónica asistida (PEA) en reducir estos errores.

*Corresponding author.

E-mail address: silvia.garcia80@hotmail.com (S.E. García-Ramos).

Prescripción electrónica asistida

Métodos: Estudio observacional, prospectivo, en el área de hospitalización. En una muestra representativa, se revisaron los cambios de tratamiento de las prescripciones médicas en las 24 horas previas a la observación. Se detectaron los errores de transcripción identificando la no concordancia entre la prescripción médica y la hoja de administración de enfermería. Se calculó la incidencia de los errores de transcripción total y por unidad clínica, tipo de error, vía de administración y gravedad potencial asociada. Se estimó el impacto de la disminución del número de errores nuevos/día si se implantara la PEA en todas las unidades.

Resultados: De las 416 prescripciones revisadas el porcentaje global de errores de transcripción fue del 12,4%, siendo del 9,8% en las unidades médicas y del 15,2% en las quirúrgicas. Los tipos de error más prevalentes fueron por añadir un medicamento nuevo (29,4%) y en la frecuencia de administración (27,4%). El 98% no produjeron daño al paciente y el 57,7% correspondió a la Categoría C. Con la PEA se evitarán 69 errores nuevos diarios en las unidades de hospitalización.

Conclusiones: Los errores de transcripción tienen una magnitud suficientemente importante como para tenerlos en cuenta a la hora de diseñar estrategias para mejorar la calidad asistencial; la PEA es una herramienta eficiente que elimina los errores asociados a la transcripción de órdenes médicas.

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Introduction

Patient safety is one of the main concerns at the moment for Health Care Authorities such as the WHO, the Council of Europe and the *Ministerio de Sanidad, Política Social e Igualdad* (Spanish ministry of health, social policy and equality) as well as the regional departments in Spain. As such, it has been included as one of the objectives in the quality plan for the Spanish national health system, specifically in the clinical excellence section.¹ Medication errors are part of the safety problem and affect both the pharmacotherapy efficacy and safety. We have used the definition for medication errors employed by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP)²: “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures and systems, including prescribing, order communication, product labelling, packaging, nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use.”

It is a well-known fact that medication use is a very complex process, especially in hospitals, due to the variety and added risk of the drug used. Different studies have quantified the medication errors that occur during each stage of the health care process. The prescription error rate varies between 6.8% and 22.4% transcription error rate between 9.3% and 32.6% and administration error rate between 8.6% and 82%³⁻⁹ according to these studies.

Medication errors can be minimised through the use of new technologies, and the electronically assisted prescription (EAP) can eliminate all the transcription incidents by the pharmacy department and nursing staff on the unit. EAP was first implemented in our hospital in December 2007 and this led to medication problems decreasing by 43%¹⁰ This study provided information on the extent to which medication errors decreased after the introduction of the AEP, but it did not analyse the errors

according to the stage of the process in which they occurred. The data were obtained from the registry for medication requested by the different nurses' stations. This meant that dispensation and transcription errors were mainly detected in the pharmacy. Some nursing transcription errors were also detected but only when the medication was pre-requested. Therefore, these errors were known to be extremely undervalued. The methodology employed was not suitable to quantify the problems related with errors when transcribing treatments to the administration forms. That is why we decided to assess the incidence of errors when nursing staff transcribe prescriptions and the severity of these errors. The aim was also to assess the impact of AEP in improving the safe use of medication by eliminating errors when transcribing treatment to the nurses' administration forms.

Methods

Design and scope

We carried out a one-month prospective, observational study in which transcription errors were the main variable.

The study was carried out in the departments of internal medicine (medical units) general and digestive tract surgery, traumatology and urology (surgical units); i.e., all the units where medication was prescribed manually. All the patients hospitalised in the abovementioned units who had their medication changed during the 24 hours before the check were included in the study.

Population and sample

A sample size¹¹ of 138 treatment changes was obtained by applying an expected prevalence of transcription errors of 10% with a CI of 95% and a 5% precision of the method for observations. A prevalence of at least 10% was expected as there is a 12% transcription error rate in Spain.¹⁵ All the

treatment changes made during the previous 24 hours were checked in each unit for all the patients.

Error types

The medication transcription errors were coded in accordance with the following design:

1. Error for not adding a prescribed medication.
2. Error for not stopping a medication.
3. Error in the dose transcribed.
4. Error in the frequency of administration transcribed.
5. Error in the route of administration transcribed.
6. Incorrect transcription of the medication.
7. Error in the duration of administration transcribed.

Outcome measurements

The variables used to express the results of the study are described below.

The main variable of the study was the incidence of errors when transcribing medicine to the nurses' administration forms. A transcription error was defined as when the medical prescription and the administration form did not match. The incidence of transcription errors was calculated as the number of transcription errors over the number of observations carried out.

The following were classed as secondary variables: incidence according to type of error (according to the coding described above), route of administration, type of clinical unit (medical or surgical) and the potential severity of the error for the patient.

The potential severity of the possible errors made was measured according to the NCCMERP criteria,¹² taking into account if the error reached the patient and, if so, whether an intervention was required or the patient was harmed in any way.

The impact of implementing the AEP on all the hospitalised patients was estimated by calculating the number of errors when transcribing treatments to the administration forms which was avoided per day, per year and per patient. The number of errors avoided per day was obtained by taking into account the nurses' transcription error rate obtained in this study and that each patient in the hospital had 1 change in treatment per day and that there was an average of 438 patients/day. The errors avoided per year were obtained by multiplying the above by 365 days. The number of errors avoided per patient was obtained by taking into account the nurses' transcription error rate obtained in this study and that each patient in the hospital had 1 change in treatment per day and that the average stayed in hospital was 7.14 days.

Process of the study

The study was carried out by checking all the treatment changes in the clinical units made with manual medical prescription during the 24 hours before the check. The analysis was split up into periods of 24 hours until a representative sample was obtained. The study lasted for 1 month and checks were carried out on 1, 10, 20 and 30 May 2009. A data collection sheet was designed for this which

included the patient number, age, number of drugs administered, route of administration, transcription error found and the severity of the error. We complied with the data protection law currently in force in Spain.¹³ These data were inputted into an Excel sheet to make it easier to analyse them.

The physicians prescribed changes to treatment on a daily basis and a copy is sent to the pharmacy department so that they could be transcribed and the original was delivered to the nurse who had to transcribe them manually onto his/her administration form. No pharmaceutical check is carried out on the nurse's transcription.

The transcription errors were detected by directly comparing the original medical prescription with the nurse's administration form in each clinical unit and we analysed any inconsistencies between them. The resident pharmacist was in charge of collecting the data and any difference found in the medicine transcribed, dosage, frequency, route of administration or duration of treatment was noted as a transcription error. The check took place between 17.30 and 19.30 as this is when the changes to the nurses' administration forms had to be completed by and because. The nursing staff also had more time for the check during this time and it kept any interference with their work on the unit to a minimum.

The nursing staff were informed when an error was detected and they then corrected it on the administration form and in this way, the error did not reach the patient in subsequent administrations.

Statistical analysis

The statistical analysis was performed with PASW software, version 18 (formerly SPSS). The quantitative variables of incidence of errors according to type and potential severity were expressed as percentages over total errors and were studied using the Student's t-test. *P* values < .05 were considered to be statistically significant.

Results

A total of 443 treatment changes were checked for 416 patients (1.06 changes per patient/day). Fifty-five (55) transcription errors were found, which is equivalent to 12.4% over the total (CI 95%, 9.33-15.47).

The most common error was not transcribing a new medication (29.4%) followed by an error in the change of frequency (27.4%). The results of the analysis according to type of error are shown in Table 1.

The analysis by route of administration showed that 40% of the errors (n=22) affected the oral route and 49.1% (n=27) the parenteral route. The rest of the errors were spread out evenly between topical (5.45%, n=3) and inhaled (5.45%, n=3) routes.

The potential severity of the errors identified is presented in Table 2. The most common type was Category C (error that reached the patient but did not cause patient harm).

Medical units

Thirty (30) transcription errors (9.8%, CI 95%, 6.46-13.14) were found out after analysing the 305 treatment changes

Table 1 Transcription errors classified by type of error

Transcription errors	Overall		Medical Units		Surgical Units		Statistics
	no.	%	no.	%	no.	%	
When adding a medication	15	29.4	11	36.7	4	19	<i>P</i> <.001; <i>t</i> =22.045
When stopping a medication	11	21.6	6	20	5	23.8	<i>P</i> =.01; <i>t</i> =-4.654
Dose	6	11.8	5	16.7	1	4.8	<i>P</i> <.001; <i>t</i> =14.574
Frequency of administration	14	27.4	6	20	8	38.1	<i>P</i> <.001; <i>t</i> =-22.168
Route of administration	2	3.9	0	0	2	9.5	<i>P</i> <.001; <i>t</i> =-16.454
Incorrect medication	2	3.9	1	3.3	1	4.8	<i>P</i> =.0140; <i>t</i> =-1.837
Duration of treatment	1	2	1	3.3	0	0	<i>P</i> =.005; <i>t</i> =5.716

t indicates intervention necessary.

Table 2 Transcription errors by potential severity

	Overall		Medical Units		Surgical Units		Statistics
	n=55	%	n=30	%	n=25	%	
A	5	9.1	1	3.3	4	16	<i>P</i> <.001; <i>t</i> =-15.554
B	10	18.2	8	26.7	2	8	<i>P</i> <.001; <i>t</i> =22.045
C	32	58.2	16	53.4	16	64	<i>P</i> <.001; <i>t</i> =-12.982
D	7	12.7	4	13.3	3	12	<i>P</i> =.187; <i>t</i> =1.592
E	1	1.8	1	3.3	0	0	<i>P</i> =.005; <i>t</i> =5.716

A: circumstances or events that may cause error; B: an error occurred but it did not reach the patient; C: an error occurred that reached the patient but did not harm the patient; D: an error occurred that resulted in the need for increased patient monitoring, but no patient harm occurred; E: an error occurred that resulted in the need for treatment or intervention and caused temporary patient harm; t: intervention necessary.

(68.8% of the total changes checked) for 240 patients (1.27 changes per patient/ day).

The detailed analysis of the errors by type is shown in Table 1. It is important to mention that the most common type of error was not transcribing a new medicine.

After analysing the transcription errors according to the route of administration of the affected drug, we found that 40% (n=12) were by oral route and 46.6% (n=14) by parenteral route. The rest were shared out equally between topical (6.6% n=2) and inhaled (6.6% n=2) routes.

The potential severity of the errors identified is presented in Table 2. Overall, 96.7% of the transcription errors did not harm the patients (category A, B, C and D).

Surgical units

In all, 138 treatment changes were checked (31.2% of all checks) for 176 patients (0.78 changes per patient/ day); and 25 transcription errors were found (18.1%, CI 95%, 11.67-24.52).

The errors are shown by type in Table 1. The most common type of error was in the frequency of administration.

We found that 40% (n=10) of the errors corresponded to oral route and 52% to the parenteral route. The remaining 8% was shared equally between the inhaled (4%, n=1) and topical (4% n=1) routes.

The potential severity associated with the errors identified is presented in Table 2.

Impact of implementing electronically assisted prescription

The implementation of the EAP in our hospital will result in 54.3 errors being avoided every day, 19 824 errors/year and 0.88 errors per patient, as it eliminates the errors when transcribing treatments to the administration forms.

Discussion

The results of this study highlight how important it is to reduce errors when transcribing treatments to the administration form, which has a mean incidence of 12.4%. This will ensure that medication is correctly administered and guarantee the efficacy and safety of the pharmacotherapy. We believe that this is a high rate of incidence as we only took into account the errors that the nurses made when transcribing the treatment changes made in the 24 hours before the check. We did not assess the medication errors for using an incorrect administration technique or a different schedule from that transcribed or for administering the treatment to the wrong patient. We

also did not consider the medication errors due to incorrect transcriptions in the pharmacy department. Consequently, the results obtained are not complete but it is important to have them available to be able to make a real estimate of the effect that implementing EAP may have in reducing these errors.

An observational design was chosen because it has demonstrated the highest efficacy, according to different studies.^{9,14} It has been found to be 700 to 1000 times more efficient than a communication design.

When comparing our results with those of other studies,^{3,4} a limitation that we found was that the methodologies used in these studies were different from ours. Despite the fact that they were also observational and prospective studies, our study focussed on errors when transcribing treatments to the administration forms that occurred in the 24 hours before the check without considering any previous treatment changes. We used this method as it seemed to us that it minimised any error inherent to the methodology. Our study is the only one to focus on errors when transcribing treatments to the nurses' administration forms, while the studies mentioned above made no distinction between an error made in the transcription phase by the pharmacist or by the nurse on the ward. Furthermore, they were not designed to detect only this type of error. The study by Climent et al made a distinction in the method section between the stage of the process when the transcription error occurred but not in the results, which were expressed as overall transcription errors. These studies did not analyse the transcription errors found by type of clinical unit where they occurred. As a result, we cannot compare them with our data, which make a distinction between the different medical units. However, even though the most common types of transcription error were the same in medical and surgical units, the overall incidence was a lot higher in the surgical units. The differences were statistically significant for all types of error, except incorrect transcription of the medication ($P=106$).

Previous studies found that medication errors were predominantly associated with intravenously administered drugs,¹⁵ while in our study, a higher number of errors were obtained in parenterally administered drugs. These results were expressed as a percentage over the total number of errors found, but not with respect to the treatment changes checked for each administration route; consequently, these differences ($P<0.001$; $t=11.145$) may have been because more checks were performed for parenteral treatments and not because there is actually a higher incidence associated with parenteral administration. After checking the bibliography on which the aforementioned review is based, we were able to see that these studies were designed to determine the incidence of medication errors in intravenously administered drugs without making any comparison with oral administration. In both cases, they reached the conclusion that intravenously administration was associated with a higher incidence of medication errors (48%-49%; CI 95%, 39-57).^{16,17}

If we compare the results from the analysis by severity in the medical units with the 1999 data submitted to USP's MedMARx, the percentage of errors that caused patients harm was below 5% in both studies (category E, F, G, H and I). However, when comparing these results, we must

consider that our study has a limitation when analysing the severity of the errors, as we checked the transcriptions from the previous 24 hours (many of them made only a few hours before) and they were immediately communicated to the nursing staff for correction. For these reasons, they did not have enough time to harm the patients and therefore, we believe that the severity of some of the errors may be undervalued.

There is a 12% transcription error rate in hospitalised patients in Spain¹⁸ when nurses' and pharmacists' transcription errors are included. It is, therefore, completely justified to use as many resources as are available to minimise medication errors and to improve treatment safety. This statement is supported by the fact that it is included as one of the objectives of the quality plan for the Spanish national health system.

We must point out that the study was designed to detect errors by nurses when transcribing the treatment changes that could have continued for the whole time that the patients were hospitalised if they had not been corrected and would presumably have had a greater impact than the one detected.

When an error was detected, the nurse responsible was informed so that the error did not reach the patient. If the error was considered to have a very high potential severity, then the physician would have been informed directly, to make sure that the problem was solved immediately, but this was not required at any point during the study. It is important to mention that most of the treatment changes were prescribed during the physician's daily rounds, which were then delivered to the nurse at lunch time and were usually transcribed between 14.00 and 16.00. Therefore, in the majority of cases, the error had not reached the patient when the check was carried out and it was resolved directly with the nursing staff.

The results are deemed to be representative of the real situation as all of the hospital's medical and surgical units with manual medical prescriptions were checked on different days of the week. Therefore, they are not the results of a single unit which had problems of malpractice that are being generalised incorrectly to the rest of the hospital. A possible bias was also avoided in this way due to the fact that the patients in each specific clinical unit have different characteristics. We verified all the treatment changes made on the day of the check due to the difficulties of randomisation in this study. More treatment changes were checked in the medical units as there are more beds in these units than in the surgical units, and this is why there were more observations made than had been calculated in the sample size.

The fact that all the checks were carried out in May might have resulted in a study bias, as the incidence of errors when transcribing treatments to the administration forms would presumably be higher during the holiday periods (with less experienced staff) and the winter months (hospitals have a greater workload as more people are hospitalised).

Two studies performed before ours estimated that EAP reduces the overall rate of medication errors by 51.4%¹⁹ and 81.2%²⁰ That is why we believe that this system improves the quality of health care offered to patients enormously as it increases the efficacy and safety of the medication that patients receive while in hospital.

To conclude, transcription errors in hospitals are so significant that measures that minimise them should be implemented. Electronic prescription is a very effective tool for reducing this type of error. Therefore, it is entirely acceptable to implement this system.

However, we must be careful when using new technologies as they are not error-free; they reduce the number of human errors but we need to carry on assessing the quality of the process to be able to detect any new errors and implement the necessary improvement measures in each case.

Conflict of interest

The authors affirm that they have no conflict of interest.

References

1. Plan de Calidad del Sistema Nacional de Salud [accessed 2009 Oct 20]. Available from: <http://www.msp.s.es/organizacion/sns/planCalidadSNS/pncalidad.htm>.
2. National Coordinating Council for Medication Error Reporting and Prevention. NCCMERP Taxonomy of medication errors, 1998 [accessed 2009 Oct 26]. Available from: <http://www.nccmerp.org/aboutmederrors.htm>.
3. Font-Noguera I, Climent C, Poveda Andrés JL. Calidad del proceso farmacoterapéutico a través de los errores de medicación en un hospital terciario. *Farm Hosp.* 2008;32:274-9.
4. Climent C, Font-Noguera I, Poveda Andrés JL, López Briz E, Peiro S. Errores de medicación en un hospital terciario con tres sistemas de distribución de medicamentos diferentes. *Farm Hosp.* 2008;32:18-24.
5. United States Pharmacopeia. Summary of the 1999 information submitted to MedMARx, a national database for hospital medication error reporting [accessed 2009 Oct 26]. Available from: <http://www.usp.org/pdf/EN/medmarx/1999MEDMARXSummary.pdf>.
6. Pastó Cardona L, Masuet Aumatell C, Bara Oliván B, Castro Cels I, Clopés Estela A, Páez Vives F, et al. Estudio de incidencia de los errores de medicación en los procesos de utilización del medicamento: prescripción, transcripción, dispensación y administración en el ámbito hospitalario. *Farm Hosp.* 2009;33:257-68.
7. Marshman JA, Lam R, Hyland S. Medication Error Events in Ontario Acute Care Hospital. *Can J Hosp Pharm.* 2006;59:243-50.
8. Gutierrez Pauls L, González Álvarez I, Requena Caturla T, Fernández Capitán MC. Errores de prescripción en pacientes que ingresan en un servicio de medicina interna procedentes de urgencias. *Farm Hosp.* 2006;30:85-91.
9. Andreu C, Miquel M, Lacasa C. Detección de errores de medicación en hospitales por el método de observación. In: Errores de medicación, Prevención, diagnóstico y tratamiento. 1st ed. Barcelona: EASO; 2001. p. 143-8.
10. García Poza P, Pérez Pérez D, Baldominos Utrilla G, Luque Infantes R. Evaluación de la implantación de un programa de prescripción electrónica en cuanto a actividad y calidad. *Farm Hosp.* 2008;32(Espec Congr):76-7.
11. Pita Fernández, S. Metodología de la investigación. *Cad Aten Primaria.* 1996;3:138-14 [accessed 2010 Apr 14]. Available from: <http://www.fisterra.com/mbe/investiga/9muestras/9muestras.asp#proporcion>.
12. National Coordinating Council for Medication Error Reporting and Prevention. NCCMERP Taxonomy of medication errors, 1998 [accessed 2009 Oct 26]. Available from: <http://www.nccmerp.org/aboutmederrors.htm>.
13. Ley Orgánica 15/1999 de 13 de diciembre, de Protección de Datos de Carácter Personal. BOE 298.14-12-1999:43088-099.
14. Allan EL, Barker KN. Fundamentals of medication error research. *Am J Hosp Pharm.* 1990;47:555-71.
15. Krahenbuhl-Melcher A, Schlienger R, Lampert M, Haschke M, Drewe J, Krahenbuhl S. Drug-Related Problems in Hospitals: A Review of the Recent Literature. *Drug Safety.* 2007;30:379-407.
16. Taxis K, Barber N. Ethnographic study of incidence and severity of intravenous drug errors. *BMJ.* 2003;326:684-7.
17. Taxis K, Barber N. Incidence and severity of intravenous drug errors in a German hospital. *Eur J Clin Pharmacol.* 2004;59:815-7.
18. Abad Sazatornil MR, Carcelén Andrés J, Aibar Remón C, Arrieta Navarro R, Gómez Barrera M, Agustín Fernández MJ. Errores de medicación asociados al sistema de distribución de medicamentos en dosis unitarias. Concordancia entre observadores. *Rev Calidad Asistencial.* 2007;22:310-6.
19. Lacasa C, Polo C, Andreu C, Roure C, Martínez J, Cot R. Detección de errores de medicación en hospitales. Evaluación de la calidad del proceso de prescripción, dispensación y administración de medicamentos. *Rev Calidad Asistencial.* 1998;13:92-100.
20. Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, Ma'Luf N, et al. The impact of computerized physician order entry on medication error prevention. *J Am Med Inform Assoc.* 1999;6:313-21.