

Ergonomics applied to adverse drug events prevention in acute care hospitals: the Integrated Therapeutic Chart

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Abstract

Therapeutic errors are one of the main causes of adverse events in healthcare services. Research findings estimate a 6,5% prevalence of adverse drug events among in-patients; 1% of these ADEs resulted in patient death, 12 % in life danger, 30% in serious illness [1]. The first solution to reduce ADEs is the design and the adoption of an “Integrated Therapeutic Chart”, that is a single form for drug prescription, preparation and administration, to reduce errors in transcription and misunderstandings between clinicians, pharmacists and nurses [2].

The authors present the project to design and implement the ergonomic ITC in the 36 acute care hospitals of the Tuscany’s regional health service. A multidisciplinary work group composed by clinicians and lead by the authors was created at the Regional Centre for Clinical Risk Management, with the goals to design paper prototypes and test the ITC. 24 wards distributed in 10 hospitals, chosen to represent the clinical specialties and different safety conditions on the therapeutic process, participated at the pilot stage of the project testing for 6 months the ITC. Results show an increased quality and safety of the therapeutic process and compliance of clinicians with the ITC requirements.

Keywords: healthcare ergonomics, patient safety, adverse drugs events prevention

1. Introduction

Therapeutic errors are one of the main causes of adverse events in healthcare services. Research findings estimate a 6,5% prevalence of adverse drug events among in-patients; 1% of these ADEs resulted in patient death, 12 % in life danger, 30% in serious illness [1]. In recent years, the types and causes of therapeutic errors have been well documented as well as the recommendation to prevent recurring ADEs [3]. Failures in communicating critical information between physician, pharmacists, nurses and patients are the key problem that affect the therapeutic process [2]. Both

the quality and quantity of information are not often sufficient for the operators to guarantee an acceptable level of safety for patients assuming drugs during their in-hospital stay. As we found out in our research, often nurses have to struggle to understand drugs prescription, because of bad handwriting of physicians or even the lack of a standard chart dedicated to drugs prescription. In this paper, we present the project to design and implement an Integrated Therapeutic Chart, as a solution to prevent ADEs in the 36 acute care hospitals of the Tuscany’s regional health service. The ITC is a straightforward tool of internal communication, including all the information of the



| Cognome e Nome | | Data di nascita | Letto | Allergie segnalate | Allergie documentate |
|--|--|-----------------|--------------|--------------------|-----------------------------|
| | | .../.../... | | | |
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| | | | | Data .../.../..... | Giornata postoperatoria ... |
| | | | | Data .../.../..... | Giornata postoperatoria ... |
| Firma medico per validazione della terapia | | | | | |
| Farmaco, dosaggio e forma (singola dose) per somm. die | | Data inizio | Firma medico | | 7 12 15 19 23 |
| ORALE | | | | | |
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| Note | | | | | |

Figure 1: Example of a three days ITC

inpatient's therapeutic process. This is a good ergonomic solution to reduce errors in transcription and to avoid misunderstandings among clinicians, pharmacists and nurses.

A multidisciplinary work group composed by clinicians and lead by the authors was created at the Regional Centre for Clinical Risk Management, with the goals to design paper prototypes and test the ITC. 24 wards distributed in 10 hospitals, chosen to represent the clinical specialties and different safety conditions on the therapeutic process, participated at the pilot stage of the project testing for 6 months the ITC. We decided to start from low cost paper prototypes in order to test a set of standard requirements each ITC must have and a new procedure for managing the therapeutic process. Since the very beginning of the project, the group understood the value of an electronic chart integrated with the overall patient record and therefore decided to consider this solution as a future development of the project.

2. Materials and methods

We first analysed the therapeutic process in the different specialties through direct observation at some wards. We then split the work group in three subgroups: the first one had to define the basic safety requirements for the ITC, the second subgroup had to prepare evaluation tools, while the third was working on recommendations for technical jargon.

As the subgroups produced their results, we then designed the instructions and paper prototypes of the ITC that have been tested in a simulation using the cognitive walkthrough technique [4]. The basic requirements defined by subgroup 1 were implemented into two basic prototypes: the "one day ITC" on A4 paper for daily therapies scheduling and "the 3 days ITC" on A3 paper for up to 3 days therapies scheduling (see Fig. 1), both with information distributed on two sides. These basic prototypes were submitted to one clinician responsible for the pilot study at each ward participating at the project, together with a questionnaire for the customization of the ITC

according to the ward's specific needs. Once the questionnaires were sent back, we adapted the basic prototypes to the specific needs of the wards, without changing the basic safety requirements both for graphics and contents.

Table 1
The safety of the therapeutic process before and after the ITC

| Item | Before ^a | After ^b | Improvement |
|---|---------------------|--------------------|-------------|
| <i>Single day of hospital stay</i> | | | |
| The name of the drug is clear in the prescription | 80,7% | 94,1% | 13,4% |
| The route of administration is clear in the prescription | 64,6% | 86,4% | 21,8% |
| The physician who prescribes the therapies can be identified | 40% | 79,1% | 39,1% |
| Each prescribed dose is effectively administrated | 68,3% | 89,8% | 21,5% |
| In case of a missed administration the reason is specified | 26,3% | 61% | 34,7% |
| The nurse who administers the drugs can be identified | 54% | 82,5% | 28,5% |
| <i>Entire hospital stay</i> | | | |
| The physician who stops the therapies can be identified | 25,3% | 65,4% | 40,1% |
| All therapies effectively administered are clear and complete | 74,4% | 88% | 13,6% |

^aN=605

^bN=492

At this point, we proceeded with the implementation of the prototypes in the wards. Before and after 3 months of the implementation, we evaluated the safety of the therapeutic process using a checklist, that identifies potential ADEs in physicians and nurses records. The checklist was applied to the first thirty inpatients discharged in a sample month at all the wards participating in the pilot stage, for a total amount of 605 records analysed before and 492 after. We also evaluated the organizational impact of the ITC on work practices and power relationships with a qualitative technique: during the first and the sixth month of the testing, the responsible for the pilot study at each ward wrote a diary using a structured observation chart and informal interviews with peers. This diary was fed back

to the regional group so to help redesign both requirements and procedures and then produce the final version of the ITC.

3. Results

The usability test showed some problems with the number and presentation of the instructions, while the graphic quality and the lay-out of the ITC prototypes helped avoiding or detecting errors and was appreciated by clinicians. Therefore we decided to redesign the instructions in a simple *vademecum* using mainly visual examples of how to fill the ITC, logically segmented in 6 different areas: 1) chart ID number and side, 2) Healthcare Unit logo and ward name, 3) legend, 4) patient information, 5) drugs prescription, 6) therapies schedule.

The overall safety of the therapeutic process increased consistently on all the variables according to the data collected using the checklist before and after the introduction of the ITC. The main results are reported on table 1. 605 records before and 492 after the introduction of the ITC were analysed. 6 wards out of 24 did not finish the pilot study: in 2 cases because the ward manager changed and did not want to continue a project supported by the previous leader; in 4 cases a critical mass of clinicians in the wards did not accept to change the habits and the tools they have always used for drugs prescription and administration.

The organizational impact reported on the diary during the pilot study was high, given that traditionally physicians and nurses used to prescribe and administer using separated charts.

In general, clinicians considered the ITC as a good tool in improving safety, even if they had to change well established procedures and habits. Both physicians and nurses reported some problems related to the constraints of using paper charts, that have limited space for scheduling the therapy and no flexibility for updating the prescriptions.

After this feedback, we made slight changes to the basic safety requirements and gave more opportunities for customization. We also redesigned the ITC prototypes and added "the 5 days ITC" on A3 paper for up to 5 days therapies scheduling, with just five daily hours for administration in the face of the seven daily hours of the other two versions.

According to the modification of prototypes and requirements, the *vademecum* was also updated.

3. Conclusions and future development

This experience shows how low cost ergonomic solutions, such as the ITC, can significantly improve quality and safety of clinical practices. Our initiatives focused both on improving the organizational aspects of interactions among physician and nurses and on avoiding errors of omission and transcription. The application on a regional scale of the ITC is now supported by the results of the pilot study. Moreover, we can offer a toolkit containing the ITC prototypes, the instructions and presentation materials to the wards that will adopt this solution. An external commission will later certify those wards that are correctly using the ITC with the “good practice for patient safety award” in the management of the therapeutic process.

Next step will be the translation of the ITC requirements into UML, so to promote the development of dedicated software for the therapeutic process or the integration with the electronic patient record. In any case, we believe this must be a slow change [5] in order to let clinicians consolidate the organizational change and to get used to the new habits.

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References

- [1] Bates DW, Cullen DJ, Laird N, Petersen LA, Small SD, Servi D, Laffel G, Sweitzer BJ, Shea BF, Hallisey R, Vliet MV, Nemeskal R, Leape LL. Incidence of adverse drug events and potential adverse drug events. *JAMA*, 274 (1995) 29-34.
- [2] Leape LL, Kabacene A, Berwick DM, Roessner J. Reducing Adverse Drug Events and Medical Errors. Institute for Healthcare Improvement, Boston, 1998.
- [3] Cohen M R (editor). Medication errors. Apha publications, Washington DC, 1999.
- [4] Norman DA and Draper SW. User Centered system design: new perspectives in human computer interaction. Lawrence Erlbaum Associates, Hillsdale, NJ, 1986.
- [5] Arici C. Why hospital doctors don't use computers. *Bmj.com* [online] 325 (2002), (7372) 1090-1093.

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