Short Communication

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Assessment of an Online Training Tool for the Automated Unit-Dose Dispensing System (ADS) Process

<https://doi.org/10.1515/pthp-2019-0003>

Received December 30, 2018; revised April 09, 2019; accepted April 09, 2019

Abstract

Background: Automated unit-dose dispensing system (ADS) of oral solid medication is a complex and sensitive production process in the drug distribution system. Hence, an appropriate training of hospital pharmacy technicians (HPT) is essential. A basic training (observational and practical) of 3 weeks is first organized to evaluate the HPT, followed by an interview with both the pharmacist and the HPT chief. The importance of the human factor (daily routine and repetitive tasks) showed by the risks analysis within this process has led us to search new learning methods to keep the team engaged. An e-learning training was selected in order to further complete the HPT initial training but also as a continuous training to the HPTs who are already working in the ADS process.

Process and Methods: The e-learning tool was developed using the Google® platform and includes four theoretical training modules (Google® Slides): Module 1 “General organization”, Module 2 “Automatic preparation machine”, Module 3 “Repackaging” and Module 4 “Non-automated drug dispensing”. Each module ends with a self-assessment (Google® Forms). Various teaching materials are included: links to institutional procedures, videos, photos, quizzes, simulations ... A minimum of 75% of correct answers is requested to validate each module. The e-learning, once final, was validated with a new HPT and with five HPTs already in place for more than a year. A satisfaction form is available at the end of the training.

Results: The 6 HPTs obtained an average of 17.75/20 correct answers. The most successful modules were 1 and 4 (average per module: M1 = 18.5/20; M2 = 16.8/20; M3 = 17/20;

M4 = 18.7/20). For module 3, two HPTs scored below 75% and therefore had to pass this module again. The average time to complete this training was 1.5 hours. HPTs are 100% satisfied with the training and the teaching materials used.

Discussion/Conclusions: The e-learning tool fit well with the initial training and the continuous training of the HPTs. Its set up is simple. The duration length spent on the training is shortened for both the pharmacist and the learner. This tool is tailored to the learner needs and constraints. It allows the integration of playful and interactive teaching tool which were appreciated. An audit will be conducted to assess the impact of this training tool on the overall ADS process.

Keywords: elearning, automated dose dispensing, medication safety, hospital pharmacy, inpatient care

Introduction

According to the act defined by Article R.4235–48 of the French Public Health Code, the pharmacist must ensure the complete dispensation of the medicinal product, combining analysis with its delivery of the medical prescription, together with the information and advice necessary for the proper use of the medication. In addition, if required; the pharmacist has to prepare the drug that to be given to the patients [1]. The different steps of the medication delivery process are: prescription, dispensing, administration, monitoring and re-evaluation. Drug errors can occur at any step of the medication process in inpatient care. The IGAS (General Inspection of Social Affairs) made several recommendations on quality in its report published in May 2011, including the integration of automated systems into the hospital drug distribution system in order to make the process more fluid and secure [2]. Automated unit-dose Dispensing System (ADS) can be used to secure hospital drug delivery system, decrease medication costs, and save nurses time [3]. The ADS of oral solid medication is a new process in our

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hospital pharmacy, deployed following the acquisition of a nominative delivery system (Automated system Baxter® FDS II PROUD®) that covers approximately 600 inpatients from the geriatric unit and penitentiary center. The automated dispensing system allows the nominative repackaging of dry oral forms (tablets, capsules). The other galenic forms (syrup, oral drops, sachets, etc.) are manually prepared by hospital pharmacy technicians (HPTs). Four HPTs performed this activity daily, completed by the pharmacist in charge of the sector and a pharmacy intern. This activity has been in constant evolution since its inception and it involves motivation, teamwork and good training.

The ADS of oral solid medication is a complex and sensitive production process in the hospital drug distribution system. The preparation of doses of dry oral drugs require to an automated, computer-controlled distribution of the reconditioned dry oral forms in nominative bags, with or without the manual preparation of other drugs that cannot be automated. The Baxter® machine allows the packaging of medicines in the form of nominative bags: unit-dose, combi-dose and multi-dose. Our choice was a combi-dose packaging for each administration timepoint. The system is interfaced with the DxCare®/DxPharm® prescription support software deployed in our hospital. The analysis and pharmaceutical validation of all prescription lines is required before the medication bags can be produced. This process involves the following operations:

- Deconditioning: operation consisting in removing a unit from a pharmaceutical specialty outside its first packaging;
- Reconditioning: operation consisting in re-packaging a drug that has been deconditioned for its preparation into a new primary packaging in order to provide an aid to administration [4].

As drugs are rarely marketed in bulk form in France, the deconditioning step is essential and constitutes the limiting factor to the ADS system. The deconditioning step is carried out by an HPT in order to integrate the drugs into the automated system before being reconditioned in nominative bags. These operations can be critical in the process and must be perfectly mastered and controlled.

The ADS system can secure the medication systems, as long as the various steps of the process are perfectly controlled. Hence, an appropriate training of HPT is essential [4]. Initial practical and observational training is provided to newly arrived HPT in the ADS sector. This training takes place over 3 weeks as follows:

- Week 1: Automatic preparation machine
- Week 2: Non-automated drug dispensing
- Week 3: Repackaging

This initial training is followed by an interview with both the pharmacist and the HPT chief to evaluate the HPT. The documentation (work instructions and protocols) available within the quality system of our department also helps to ensure that the various tasks are understood and applied correctly. Nevertheless, the importance of the human factor (daily routine and repetitive tasks) showed by the risks analysis within this process has led us to search new learning methods to keep the team engaged. Traditional training systems and financial limitations do not allow us to meet all needs: people, places and time. E-learning (online training) is a great tool to train at the learner's own rhythm. It allows the integration of different media such as videos, images, documents, questionnaires, etc. A literature review of the effectiveness of e-learning in pharmacy education concluded that e-learning is effective in increasing knowledge immediately after training. However, no studies have shown that e-learning is effective in keeping knowledge in the long term. E-learning programs were considered beneficial in improving knowledge and confidence, and stimulating interest [5]. For these reasons, we decided to develop an additional e-learning type of training in order to complete the HPT initial training and also to offer a continuous training to the HPTs who are already working on the ADS process.

Materials and methods

The purpose is to monitor the implementation and interest of an e-learning training on the ADS process. This training is in addition to the initial training already provided. The e-learning, once finished, was tested by a new HPT and five HPTs who have already been in place for more than a year.

The e-learning training was developed by a pharmacy intern and a pharmacy student from the ADS sector. Videos of the different tasks were produced to include new teaching materials in the training. The training is based on the guidelines established by the CUAP (French Club of Pharmaceutical Automaton Users) [4], the procedures used in our establishment and technical documentation (automaton and deconditioning machine). The final e-learning training was validated by the head of the pharmacist. The platform chosen as training support is the Google® platform. This platform shares documents in

PowerPoint format (Google slides®) for theoretical training and also evaluations (Google forms®). Four theoretical training modules have been developed to cover all the processes and activities encountered in the ADS process. These training modules are structured as follows:

- **Module 1 “General organization”:** Refers to the global organization of the sector, including the work environment, good practices, hygiene and safety rules.
- **Module 2 “Automatic preparation machine”:** Resumes the functioning of the automaton, production controls and production recording.
- **Module 3 “Repackaging”:** As the most risky steps in the process, a module is dedicated to the deconditioning and reconditioning steps.
- **Module 4 “Non-automated drug dispensing”:** Resumes the management of drugs that cannot be automated like drugs in a dosage form other than dry oral forms (for example, oral drops), carcinogenic, mutagenic and reprotoxic drugs, antibiotics (not to induce cross-resistance) and yeasts.

These modules provide a theoretical overview of the training on the different items of the ADS process. Each module ends with a self-assessment (Google® Forms). These evaluations are used to validate the pharmacy technician's knowledge acquisition in the various items in the ADS process and to highlight a professional practice that may have not been acquired. Most evaluations include multiple-choice questions (MCQs) and exercises. The answers are given after each evaluation with comments to explain the expected answers. To validate the training, the HPT evaluated must obtain at least 75 % (15/20 points) of correct answers per module. In the event that one or more modules are not validated, the results will be discussed with the pharmacist in charge of the sector in order to understand any poorly understood topics. The HPT will then have to repeat the unvalidated module including the

theoretical module and the self-assessment attached. At the end of the training, a satisfaction form was available in order to give feedback on experience and to consider improvements to the training. To realize this e-learning training under optimal conditions, time was given to HPT and a room outside the sector was made available with a computer. The training process and the platform were presented earlier on a team meeting.

The data collection was performed using the answers to the 4 evaluations proposed by the e-learning training and the satisfaction form. The new HPT is identified as “HPTt” and the HPTs already in place for more than a year are identified as “HPT 1 to 5” for the data collection. This is a simple descriptive analysis and the data are presented according to the traditional methods of descriptive statistics: percentage, average and extreme values.

Results

The Google platform was chosen as an e-learning support. The four theoretical modules are numbered from 1 to 4 as well as the self-assessments. A satisfaction questionnaire is also available at the end. The HPT can carry out the training in the order of his choice, but we recommend the proposed numerical order. The e-learning was developed over a semester. The time spent by the intern in pharmacy to implement this e-learning could not be measured exactly. But it is obvious that the implementation of this training requires a time investment. The items discussed in each module and practical examples are summarized in Table 1. Different teaching materials are used in these modules: photos, practical examples, links to institutional procedures, videos, etc.

The 6 HPTs obtained an average of 17.75/20 correct answers. The results are presented by module and are summarized in Table 2. The overall average for module 1

Table 1: General results.

	General organization	Automatic preparation machine	Repackaging	Non-automated drug dispensing	Total	Average
HPT1	17/20	15/20	17/20	16/20	65/80	16,25/20
HPT2	16/20	18/20	17/20	18/20	69/80	17,25/20
HPT3	20/20	15/20	14/20	18/20	67/80	16,75/20
HPT4	20/20	18/20	20/20	20/20	78/80	19,5/20
HPT5	20/20	17/20	20/20	20/20	77/80	19,25/20
HPTt	18/20	18/20	14/20	20/20	70/80	17,5/20
Average	18,5/20	16,8/20	17/20	18,7/20	71/80	17,75/20

Table 2: Content of the modules.

Module	Items	Practical example	Related question
Module 1	<ul style="list-style-type: none"> -Drug distribution system -Purposes of the ADS system -Production planning -Delivery organization -Controls and double-checking -Work environment -Good practices -Stock management -Hygiene -Safety rules 	<p>Work environment</p> <ul style="list-style-type: none"> • The doors of the ADS sector must always be closed. • Daily checking of temperature and humidity • HYGIENE (<i>Instruction DNAC 016/01</i>) <ul style="list-style-type: none"> – Simple hand washing with mild soap – Hygienic hand rubbing with a hydro-alcoholic solution before performing technical operations. • HOLDING FOR PREPARATION OPERATIONS <ul style="list-style-type: none"> – Surgical hair net – Mask – Gloves – Non-sterile single-use blouse (to be changed daily)	<p>Regarding the work environment, what are the rules to be respected? *</p> <p>☐ The doors of the ADS sector can remain open during the day, but must be closed at the end of the day.</p> <p>☐ The temperature and humidity of the ADS sector must be checked daily</p> <p>☐ Handwashing with mild soap is enough to carry out the technical tasks.</p>
Module 2	<ul style="list-style-type: none"> -Unit dose distribution -Medication Pouches -RFID drug cassettes -Detachable Tablet Adapter -Production controls -Production recording -Maintenance and cleaning -Replacing packing paper 	<p>Detachable Tablet Adapter (DTA)</p> <p>The DTA ensures the safe manual preparation of specialities that are not on cassette or fractions of a dose.</p> <p>The specialities prepared at the DTA are:</p> <ul style="list-style-type: none"> -Specialities with low consumption -Specialities whose dose can be tablets $\frac{1}{2}$ or $\frac{1}{4}$ 	<p>The specialities prepared with the DTA are:</p> <p>☐ All specialities in capsule form</p> <p>☐ Low consumption specialities</p> <p>☐ Scored tablets</p> <p>☐ Oral drops</p>
Module 3	<ul style="list-style-type: none"> -Deconditioning activity -Deconditioning machine -Bar coding systems -Cassette filling -Double checking -Maintenance and cleaning 	<p>Cleaning of the deconditioning machine</p>	<p>Check the true answer(s) regarding the cleaning of the deconditioning machine:</p> <p>☐ I use a dry compress</p> <p>☐ I use a wet compress</p> <p>☐ I use a compress soaked in isopropyl alcohol</p>
Module 4	<ul style="list-style-type: none"> -Specialties concerned by the non-automated drug dispensing -Patient Identification -Case studies -Drug storage 	<p>Non-automated drug dispensing</p> <ul style="list-style-type: none"> • Attach a patient label to the bag or plastic cups depending on the galenic formulation. • Check that the following elements match with the patient's label and prescription: <ul style="list-style-type: none"> – name, – first name, – gender, – date of birth.	<p>Regarding the step of drug administration by the nurse, what is the true answer?</p> <p>☐ The nurse asks before administration the patient's surname and first name</p> <p>☐ The nurse asks for the surname, first name and checks the patient's usual treatment before administration</p> <p>☐ The nurse asks before administration the patient's surname, first name and date of birth</p> <p>☐ The nurse asks before administration the patient's surname, first name, date and place of birth</p>

is 18.5/20 points. For this module there was no question less successful than the others. The overall average for module 2 is 16.8/20 points. The least successful question in module 2 with 3 of 6 correct answers concerns the storage of the medication box in the automated system.

The overall average for module 3 is 17/20 points. The least successful question in module 3 with 3 of 6 correct answers concerns a practical exercise on the deconditioning activity. The overall average of module 4 is 18.67/20 point. The least successful question in module 4 with

4 of 6 correct answers is about the administration of medication by the nurse.

The average time to complete this training was 1.5 hours. Satisfaction was graded in 4 levels: Very satisfied/Satisfied/Unsatisfied/Very unsatisfied. Results obtained for the various items in the satisfaction form are presented in figure 1.

To get an idea of the effectiveness of the e-learning implemented, we collected the non-conformities recorded on the ADS process over a period of 6 months before and after the training. Forty-six non-compliances (0.008 % of non-compliances compared to the overall number of doses prepared), including twenty related to non-automated drug dispensing) were recorded during the six months preceeding the training. Sixty-three non-compliances (0.011 % of non-compliances compared to the overall number of doses prepared), including thirty-nine related to non-automated drug dispensing, were recorded during six months after the training.

Discussion

The online training was a success for the HPTs with an overall average of 17.75/20 points. HPTs are satisfied with the training and the teaching materials used. The most successful modules were module 1 “General organization”

and module 4 “Non-automated drug dispensing”. The less successful modules were module 2 “Automatic preparation machine” and module 3 “Repackaging”. For module 3, two HPTs (HPTt and HPT 3) scored below 75 % and therefore had to pass this module again. Modules 2 and 3 were intentionally more difficult than the other modules because they cover technical acts and critical points in the ADS process.

The HPTt is in the mid-range with an overall score of 17.5/20 points. It shows a good acquisition of the initial observational and practical training of 3 weeks. HPT 1 was the least successful in the training. This can be explained by the fact that this HPT performed the training first. The HPTs were then able to share with each other the questions and expected answers. This sharing is not problematic for training; it allows an exchange on the ADS process and the main points to remember.

The results of the evaluations and the satisfaction form revealed a question that was not well answered in the module 2. In corrective action we have modified the question to ensure that there is no double meaning. The results of the evaluations also revealed some less well acquired knowledge by HPTs, such as the question concerning the administration of drugs by nurses. This question is a reflection on the importance of the information found on the packaging bag of dry oral forms and non-automatic bags:

Figure 1: Results of the satisfaction form (N = 6).

Surname, first name and date of birth. The purpose here is to alert the preparer to identity vigilance.

The development of this training identified HPTs weaknesses in the process. For example, during the production of the videos, manipulation errors were detected. The production of videos as a training support provides a perspective and a vision of the actions carried out on a daily basis in order to reveal the actions to be proscribed. Moreover, 50% of HPTs are very satisfied and 33% are satisfied with the teaching materials used for this training. Using exercises as practical cases is also essential in order to encourage HPTs to think about concrete daily situations. Exercises have been proposed, particularly for training on deconditioning.

The estimated time to complete this training (1.5 hours) seems to be correct. A too long training may get loss of attention from the learner and a too short does not cover all the processes well enough. The implementation of e-learning training requires an initial investment time that is quickly made profitable: absence of trainer, precise and better targeted training content.

The effectiveness of the e-learning implemented was not measured. We have noticed an increase in non-compliances recorded over the post-e-learning period. Non-compliances are increasing in the non-automated drug distribution sector. This can be explained by a 20% increase in the activity of this sector at the time of e-learning implementation and better traceability of non-compliances. Several studies presented in a literature review on the effectiveness of e-learning in pharmacy education used a pre-post knowledge test to measure the effectiveness of e-learning [5]. This would be an area for improvement. Nevertheless, an audit will be carried out on the overall ADS process and the recording of traceability data.

Conclusion

The e-learning tool fit well with the initial training and validates the HPT to work on the ADS process. It also ensures continuous training of the HPTs. This online

training focuses on the critical steps of the ADS process and reminds the key messages of the initial training. Its set up is simple but it requires a significant initial investment in time. Its implementation has led us to detect manipulation errors made during routine operations and to put in place corrective actions. The platform integrates different teaching materials (links to institutional procedures, videos, photos, quizzes, simulations etc.) which are appreciated by the learners. The e-learning will have to be updated over time and according to evolving processes. An audit will be conducted to assess the impact of this training tool on the overall ADS process.

Conflict of interest statement: The authors state no conflict of interest. The authors have read the journal's Publication ethics and publication malpractice statement available at the journal's website and hereby confirm that they comply with all its parts applicable to the present scientific work.

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