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Impact of Computerization of the Pharmaceutical Products Circuit at Mohammed V Military Teaching Hospital, Rabat, after One Year of Operation

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Abstract | **Original Research Article**

Computerization of the pharmaceutical products circuit is essential for the proper functioning of the hospital pharmacy. It helps control the pharmaceutical supply chain, optimize expenditure, and ensure traceability throughout the entire pharmaceutical products circuit. The objective of this study was to assess the impact of this new system on the pharmaceutical supply chain after one year of operation. This was a survey conducted over a one-month period. Data were collected using two types of questionnaires: one intended for pharmacy staff and the other for staff working in care units. A total of 104 people took part in the survey, of whom 58.65% were female. In addition, 48% were under 30 years old, 64.42% had used the information system for more than one year, 63% had received training on the computerized tool implemented, 81.75% considered the ergonomics of this system easy, and 69.23% reported that the information system used improved prescribing quality. Among pharmacy staff, 61.11% reported that this system improved the quality of pharmaceutical validation, 65.05% considered that it enabled better management of pharmaceutical products, and 69.23% stated that the system improved teamwork and communication with care services. Among physicians and nurses, 50.77% reported that the information system enabled them to optimize working time, 48% were very satisfied with the service provided by this system, and 95.19% preferred the information system to handwritten prescriptions. This study shows that computerization has a positive impact on improving the quality of the pharmaceutical products circuit and on the quality of work among HMIMV staff.

Keywords: Pharmaceutical products, information system, pharmaceutical management, computerized prescription.

INTRODUCTION

The management of health risks in the hospital setting has become a priority for improving the quality of care, accreditation, and recognition of patients' rights [1]. Improving the quality of the pharmaceutical products circuit is an integral part of this priority.

Mastering the information system is a fundamental prerequisite for optimizing the logistical and clinical circuit of pharmaceutical products, particularly the traceability of the entire circuit and the management of flows throughout the supply chain (supplier, delivery, receipt, storage, distribution, and patients). The information system makes it possible to optimize and coordinate the organization and functioning of the different stakeholders in the supply chain. It is therefore necessary to have an information system capable of controlling and managing the entire pharmaceutical supply chain and thereby optimizing expenditure.

The new information system with computerized prescription (ESCULAPE PHARNET) was implemented in early 2020 within the Pharmacy Department of Mohammed V Military Teaching Hospital, Rabat.

We conducted a study whose objective was to assess the impact of computerized prescription on the pharmaceutical supply chain and the quality of care after one year of operation.

MATERIALS AND METHODS

This was an observational study with a

descriptive purpose. The work was carried out using two types of questionnaires:

- A questionnaire intended for pharmacists and pharmacy technicians. It focused on the ergonomics of the information system implemented, the contribution of this system to stock management, and the level of staff satisfaction.
- A questionnaire intended for physicians and nurses, covering staff-related information, the ergonomics of the information system, the contribution of this system to prescription quality, improvement in the quality of patient care, and the level of staff satisfaction.

The questionnaires were anonymous. All data were collected in accordance with ethical and professional conduct rules. Statistical analysis was performed using Excel and SPSS STATISTICS 21.0.

1. Results of the questionnaire assessing the impact of computerization of the pharmaceutical products supply chain after one year of operation

A total of 104 people took part in the survey, of whom 58.65% were female. In addition, 48% were under 30 years old, 64.42% had used the information system for more than one year, 63% had received training on the computerized tool implemented, 81.75% considered the ergonomics of this system easy, and 69.23% reported that the information system used improved prescribing quality. Among pharmacy staff, 61.11% reported that this system improved the quality of pharmaceutical validation, 65.05% considered that it enabled better management of pharmaceutical products, and 69.23% stated that the system improved teamwork and communication with care services. Among physicians and nurses, 50.77% reported that the information system enabled them to optimize working time, 48% were very satisfied with the service provided by this system, and 95.19% preferred the information system to handwritten prescriptions.

ANALYSIS AND DISCUSSION OF RESULTS:

2. Staff training

According to the results of our survey, 63% had received training on the computerized tool used, compared with 37% who reported that they had not received any training. The percentage of untrained staff is explained by the fact that training was scheduled at the time the system was first implemented; therefore, only staff present during that period benefited from this training.

3. Ergonomics of the information system

ISO 9241-11:2018, relating to ergonomics of human-system interaction, provides guidelines on usability. According to this standard, a system is usable when it enables identified users to perform their tasks with efficiency, effectiveness, and satisfaction within the specified context of use [2].

According to a study conducted in Algeria in a hospital and university establishment in Oran, information-system ergonomics received 60% positive opinions (easy) versus 32% negative opinions (difficult) [3]. The results of our study are consistent with the literature: in our survey, 81.73% considered the ergonomics of the implemented information system easy, 16.35% considered it very easy, and 1.82% considered it difficult.

Analysis of the data from the present study indicates that 13.46% of women answered that the system ergonomics were very easy, compared with only 2.88% of men. According to the statistical results, the difference between the two groups was significant. It can therefore be concluded that sex influences the use of this system.

Table II: Comparison between men and women regarding use of the information system

Crosstab: relationship between sex and system ergonomics.						
Count						
		System ergonomics				Total
			Difficult	Easy	Very easy	
Q2	Sex					
	Female	0	1	46	14	61
	Male	0	1	39	3	43
Total			2	85	17	104

Chi-square tests			
	Value	df	Asymptotic significance (two-sided)
Pearson chi-square	142,172[a]	6	,000
Likelihood ratio	153,571	6	,000
Number of valid observations	104		
a. 4 cells (33.3%) have an expected count less than 5. The minimum expected count is 0.47.			

4. Relationship between age and use of the information system

The p-value, or asymptotic significance, was below 0.05, indicating a significant difference between the different age groups regarding the use of the implemented information system. It can therefore be concluded that age influences the use of this system.

Table III: Comparison by age regarding use of the information system

Crosstab: relationship between age and system ergonomics						
Count						
			Information-system ergonomics		Total	
			Difficult	Easy	Very easy	
Q3						
	Between 30 and 40 years		0	27	8	35
	Under 30 years		2	42	6	50
	Over 40 years		0	16	3	19
Total			2	85	17	104

Chi-square tests			
	Value	df	Asymptotic significance (two-sided)
Pearson chi-square	140,950[a]	9	,000
Likelihood ratio	152,916	9	,000
Number of valid observations	104		
a. 8 cells (50.0%) have an expected count less than 5. The minimum expected count is 0.28.			

5. Information-system failures

Among the disadvantages of an information system is the risk of failures. In our study, 78% (81) of participants (pharmacists and hospital-department staff) reported malfunctions or failures of the information system. Our results are similar to those reported in the literature. A study conducted at Hassan II Hospital in Agadir on the impact of information and communication technologies on improving the quality of hospital services showed poor use of these technologies, mainly due to recurrent failures and lack of technical support. In that study, 2.9% stated that they were opposed to developing or improving ICT within the hospital because, in their opinion, in the event of any failure, this technology would become a source of work slowdown [4].

6. Frequency of information-system failures

Among the 78% who reported computer failures, 51.14% considered that these failures were rarely encountered. The benefit-risk ratio of this system remains largely positive.

Our results are consistent with the literature. A study conducted in 2019 at the University of Picardie showed that the role of the hospital computer system remains important despite repeated system malfunctions, which must be addressed [5].

7. Solution chosen by staff in the event of failures

In the event of a computer failure, 44.12% of users contact the technician responsible for the hospital's IT Department. Indeed, HMIMV has 40 IT technicians distributed by department; their role is to support hospital-department staff when using the information system, intervene in the event of failures or malfunctions, and provide staff training in the use of the hospital information system.

To ensure continuity of service operation, other alternatives are possible in the event of computer failures. This is the degraded-mode solution. To avoid disruption of services and blocking of pharmaceutical product requests in the event of a computer failure, a procedure was developed by the SIP unit of the Pharmacy Department in collaboration with the hospital IT Department. This procedure describes the conduct to be followed by hospital departments and the pharmacy in the event of a computer failure.

Several published studies have addressed degraded-mode solutions in the event of computer failures. In another French study, within the framework of the 2007 Good Pharmacy Practices and V2010 certification, hospital pharmacies were required to implement a procedure and a tool to ensure continuity of the chemotherapy circuit in the event of malfunction or failure of the computer system. The objective was to manually and safely reproduce the different computerized steps from prescription through to the printing of preparation sheets, according to the format of the CHIMIO software [6].

8. Ease of access to information via the information system within clinical departments

In our survey, 76.92% of physicians and nurses considered that access to the desired information (patient consumption, overall department allocation, etc.) was easy. This may be explained by the simplicity of the information system implemented. Indeed, among the criteria for an efficient information system, the ergonomics of the tool used and access to the requested

information must be easy and adapted to each user profile.

Our results are consistent with the literature. A study conducted in 2016 at a hospital and university establishment in Oran, Algeria, showed that the information system reduces the time required to access and transmit medical information; patient information is immediately available and accessible from any computer workstation [7].

9. Ease of access to the desired information via the information system within the pharmacy

Ninety-four percent of pharmacy staff (pharmacists and pharmacy technicians) considered the current information system easy or very easy to use. This may be explained by the simplicity of the software implemented. Indeed, one of the objectives of an information system is ease of use by users. Our results are consistent with the literature. A study conducted in the Clinical Pharmacy and Biomaterials Department of the Bichat-Claude-Bernard Hospital Group in France showed that the disadvantages of the handwritten procedure (difficulty searching, time required, data-entry errors, etc.) convinced the pharmacy to work with the IT department to computerize traceability. Thus, after computerization of the sterile implantable medical device circuit, users reported that the information system used was user-friendly and easy to use, both for recording the implantation of a sterile implantable medical device and when searching the database. Use of the information system therefore saved time for this working group while avoiding the risk of data-entry errors and optimizing the sterile implantable medical device circuit [8].

10. The information system helped prevent prescription errors

In our study, 74% of clinical-department staff reported that the implemented information system helps minimize, or even prevent, prescription errors.

Our results are consistent with the literature. According to a 2008 study conducted at Percy Military Teaching Hospital in France, it was estimated that more than 50% of preventable adverse events could have been avoided with computerized prescription. Indeed, computerized prescription helps detect prescription errors such as drug interactions or patient-inappropriate dosage [9].

11. Impact of the information system on prescription quality

Numerous studies have shown that an information system improves prescription quality. In a comparative study conducted in 2012 at Henri Poincare University, Nancy, France, 169 handwritten prescription lines and 154 computerized prescription lines were analyzed based on five prescription criteria: prescription date (95.9% of cases versus 100%), prescriber's name (0% versus 100%), signature (38.5% versus 97.4%), dosage of the prescribed drug (78.7% versus 98.7%), and pharmaceutical form (64.5% versus 100%). Overall, 18.2% of handwritten prescriptions met this requirement, compared with 72.3% of computerized prescriptions. The results of this study show that the information system optimizes prescription quality in its drafting process across at least five criteria. The authors found a statistically significant difference in favor of computerized prescription [10].

Furthermore, another study conducted at the Besancon University Hospital, within the regional reference oncology center, included all prescriptions (protocols) issued from January to June 2005. All computerized prescriptions (protocols) underwent pharmaceutical analysis (by a pharmacist or pharmacy resident). The results of this study demonstrated the effectiveness of computerized prescription in preventing prescription errors [11].

Indeed, the information system is an effective tool for preventing prescription errors. Computerization of prescribing helps minimize, or even avoid, certain errors encountered with paper prescriptions, including those related to poor handwriting [12]. All participants in our survey agreed that the information system helps prevent prescription-related errors, particularly those involving pharmaceutical form, dosage regimen, or nomenclature. The results of our study are consistent with those reported in the literature.

12. Pharmaceutical validation of prescriptions

Several studies have addressed the value of the information system in pharmaceutical validation. In a study conducted at Grenoble-Alpes University Hospital in 1999, whose objective was to assess clinical pharmacy activity in a department where the medication circuit was computerized, the pharmacy team analyzed and validated each new prescription or prescription modification. Over six months, 31% (795) of prescriptions were modified following pharmaceutical validation. Proposed modifications included substitution by an equivalent or generic drug, change in route of administration, and dosage modification. Sixty-five percent of physicians responded favorably to pharmacists' proposals after pharmaceutical validation of prescriptions. The pharmacy team considered that prescription computerization enabled the pharmacist to perform his or her role in analyzing and validating prescriptions in care departments [13].

In our survey, 84.62% of pharmacists and pharmacy technicians used the information system to validate prescriptions; among them, 61.11% reported that the information system improved the quality of pharmaceutical validation of prescriptions sent by departments. Our results are consistent with the literature. Impact of the information system on the management of pharmaceutical products in the pharmacy

and care units

Among users, 65.05% reported that the information system optimized the stock of pharmaceutical products in their departments. The results of our study are consistent with several studies. Thus, Botte A. *et al.,* in a study on stock management of pharmaceutical products in a pediatric intensive care unit, found that after implementation of an information system, immobilized (dead) stock decreased by 69% (EUR 94,816 in value) and by 18% in the number of references stocked in the department, enabling better stock optimization [14].

In a similar study conducted in France in 1999, six months after installation of pharmaceutical dispensing software (SAUPHIX), a questionnaire evaluating each software function was distributed to hospital-department staff. They found that stock levels and expired medicines in department cabinets were reduced. The results of this study showed that the software implemented enabled more rigorous management of medicines within hospital departments [15].

13. Impact of the information system on securing the pharmaceutical products circuit

Medication errors are a cause of therapeutic failure and iatrogenesis and may be responsible for morbidity or even mortality. It is therefore useful to secure the pharmaceutical products circuit and to improve and guarantee the quality of care delivered to patients. Computerized prescription contributes to securing the pharmaceutical products circuit [16].

In this context, several studies have been conducted, including one in 2009 at San Salvadour Hospital, a care and rehabilitation facility. The pharmaceutical products circuit in this department was not computerized. After a one-week evaluation study, the authors described errors generated during prescription, validation, and dispensing of pharmaceutical products, then assessed the evolution of this circuit after implementation of corrective actions for the errors observed. After three evaluations, the rates of pharmaceutical interventions were 16%, 6%, and 12%, respectively, after each medical prescription; the error rates in pillbox preparation were 1.3%, 5.7%, and 0.3%; and treatment-administration error rates were 9.5%, 3.9%, and 5.5%, respectively. These errors were not recorded by nurses. The authors concluded that computerization of the entire pharmaceutical products circuit is therefore an essential tool for better security of pharmaceutical products and good patient management, in which the pharmacist plays a very important role [17].

In addition, a study by Francois Chast et al. showed that implementation of computerization of the pharmaceutical products circuit made it possible, in addition to securing therapeutic resources and achieving substantial savings, to provide nurses with increased availability for patients [18].

In our study, 67% of participants considered that the information system enabled better security of the pharmaceutical products circuit. Our results are consistent with the literature.

14. Impact of the information system on inventory performance

The annual inventory makes it possible to calculate stock variations between the beginning and the end of the fiscal year, thereby revealing leakage and dormant stocks. It must be performed at the end of the accounting period and requires interruption of activity. In hospital pharmacy, inventory is considered a heavy task; it concerns all stocked products and mobilizes the entire staff. The computerized tool should facilitate inventory performance for users.

A study was conducted at the Regional Hygiene Department of Bizerte, Tunisia, in 2011, where the computerized tool used was described. During inventory, the software prints the inventory of existing stocks and the manager of each stock must verify and confirm the software inventory. Any discrepancy automatically triggers verification procedures [19]. In our study, 69.23% of pharmacy staff considered that the information system made inventory easier. Our results are consistent with the literature.

15. Role of the information system in reducing dispensing errors

In a study conducted in 2012 at Montelimar Hospital Center in France, comparing dispensing with paper prescriptions and computerized prescriptions, the authors observed 9 errors per 233 dispensing lines (3.9%) versus 3 per 300 (1.0%) with the new organization (computerized prescription). The authors concluded that computerized prescription reduced dispensing errors [20].

Furthermore, another study conducted in the gerontology department of Rene-Muret Hospital in 2001 showed that implementation of computerized prescription further improved the dispensing chain while preventing dispensing errors [84]. Common dispensing errors include errors in pharmaceutical form and prescribed dose.

The results of our study are consistent with the literature; 64% of participants confirmed that the implemented information system helped minimize dispensing errors compared with paper requests.

1. Savings generated by the information system (pharmacy department):

An observational study was conducted in the emergency medical and resuscitation service (SMUR) at Henri-Mondor Hospital in France. The objective was to

assess the economic impact on pharmaceutical product stock after use of the information system. SMUR activity increased by approximately 10% between the two periods, whereas pharmacy expenditure decreased after installation of the computerized management system. The average medication expenditure per intervention decreased to EUR 9 instead of EUR 13. The estimated saving during the study period was EUR 134,000. Stock management became simpler and the number of orders decreased and became less frequent after implementation of the new information system [2].

In our study, 48.72% of pharmacists reported that the new computerized prescription system enabled them to generate savings, which is consistent with the literature.

16. Information system and optimization of pharmacy staff working time

Pharmacy technicians are often insufficient in number in relation to the tasks assigned to them, which requires rigorous management of working time.

A study conducted in France in 2012 assessed the tasks and working time of pharmacy technicians before and after implementation of computerized software. The results showed that 100% of technicians (9/9) perceived an enhancement of their work after installation of the new information system, because the number of visits to the pharmacy counter decreased. They also observed that the number of dispensing errors decreased, making this process more secure [20]. This enabled technicians to optimize working time and better manage their tasks during the day.

In our study, 56% confirmed that the information system enabled them to optimize their working time, which is consistent with the results of studies published in the literature.

17. Optimization of care staff working time

A study conducted at Liege University Hospital assessed care staff working time before and after installation of a computerized prescription system. A time saving of approximately 80 minutes per day was noted after use of this system. This made it possible to devote more time to patient care and to administrative and logistical aspects within care departments. The authors also noted a time saving in the delay between medical prescription and medication delivery by the pharmacy (32 +/- 6 minutes instead of 253 +/- 91) [21].

Furthermore, in another study conducted in France in 2014 on assessment of the impact of computerized prescription on quality of care, the authors found that implementation of the computerized tool induced major changes in care organization, particularly optimization of time and staffing, which had a positive impact on quality and safety of care [22].

Our result is consistent with many studies showing a relationship between the information system and working-time savings, allowing more time for care activities.

18. Improvement of patient care quality through the information system

A study conducted in 2017 showed that the information system facilitates access to information for all stakeholders involved in patient care and reduces the risk of errors related to prescription, dispensing, or administration of treatments. The authors concluded that the information system is a cornerstone of patient management and that mastering it is crucial to ensuring high-quality care [23]. Our results are similar to those in the literature, since 56.92% of care-unit staff observed an improvement in the quality of care after implementation of the new information system.

19. Effect of the information system on teamwork and communication between pharmacy staff and care-department staff

A study conducted by Schmitt et al. showed that the information system for the medication circuit promoted communication between prescribing physicians and pharmacists [24].

Another study conducted in France showed that 67% of pharmacy technicians confirmed an improvement in communication with hospital departments after implementation of computerized prescription [20].

However, a study conducted at Fez University Hospital on analysis of hospital information system performance showed that interpersonal communication remained difficult within the institution even after implementation of a hospital information system [26]. This may be explained by the presence of multiple departments within the hospital, making it difficult to establish a means of communication between the pharmacy and the different care departments. In that study, the collective objective was not clearly perceived and work organization therefore did not appear to be adapted.

In our study, 61.54% of participants confirmed that the information system enabled better communication among pharmacy staff. In addition, 69.23% of pharmacy staff confirmed that the information system implemented in early 2020 improved teamwork and communication with care departments.

i. Level of satisfaction among information-system users

A study conducted by L. Zemour et al. in 2019 showed that more than 70% of users were satisfied after using a hospital information system [27]. Another study conducted in Algeria after implementation of the electronic medical record showed that users were satisfied with this tool, which facilitated access to

information for all healthcare professionals [28].

Furthermore, another study conducted in 2000 at the University of Lausanne aimed to assess the added value of an information system in intensive care. This survey showed that, overall, users were satisfied with the information system and did not wish to return to handwritten prescriptions [29].

In our study, 97% confirmed their satisfaction with the use of the computerized prescription system, which is consistent with the literature.

ii. Information system or paper-based system

In our survey, 95.19% of participants preferred the information system to paper prescriptions, compared with 4.81%. This choice was due to staff satisfaction (97%) with the implemented system. Our results are consistent with numerous studies in the literature. Thus, in a study conducted in three university hospital centers in Abidjan (Cote d'Ivoire), 95.12% of pharmacists expressed their wish to computerize the pharmaceutical products circuit, as well as pharmaceutical analysis and validation of prescriptions [30].

CONCLUSION

This study has concretely demonstrated the impact of computerization on optimizing stock management, working time, and security of the pharmaceutical products circuit. It also enabled improvement in the quality of patient care and better communication between care-department staff and the pharmacy. This information system also improved the quality of prescription and pharmaceutical validation of prescriptions; it also reduced the risk of errors related to prescription or dispensing (dose errors, dosage-regimen errors, etc.).

It can therefore be concluded that the impact of the information system on the pharmaceutical products circuit is positive. A subsequent and more in-depth study would be useful to better evaluate the information system used and allow users to propose suggestions for improvement.

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