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ORIGINAL PAPER

MODELLING MEDICINAL PRODUCTS INVENTORY MANAGEMENT PROCESS IN HOSPITALS USING A METHODOLOGY BASED ON THE BPMN STANDARD

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ABSTRACT. **Background:** Pharmacotherapy, or treatment using medicinal products is one of the therapies used as a treatment method in hospitals. According to estimates, an average hospital in Poland manages ca. 130 thousand medicinal products and these products make second biggest – after salaries – cost intensive element in operation of a hospital. Taking into consideration the need to ensure an adequate patient service level, especially in the field of patient safety regarding pharmacotherapy, medicinal products inventory management is a key area of hospital processes. The aim of the article is to present assumptions of modelling medicinal products inventory management process in hospitals using a methodology based on the BPMN standard concentrated on process efficiency improvement.
Methods: The research was conducted in three hospitals in the Wielkopolska Province between January 2015 and December 2015. As part of the applied methodology, process approach was used exploiting complex identification of business roles, activities and events in the analysed processes. The research was concentrated on medicinal products inventory management processes in hospitals.
Results: In the article, modelling medicinal products inventory management process using a methodology based on the BPMN standard has been presented and described. The authors present process approach in the analysis of the problem regarding streamlining of inventory management process, with a special focus on real-time access to data concerning: type, location and level of medicinal products inventory.
Conclusions: Medicinal products inventory management in a hospital is a complex and multi-layered process, also due to the large number of legal requirements in the field in question. The conducted research proved usefulness of process approach using a methodology based on the BPMN standard in the field of streamlining of medicinal products inventory management process. The authors recognise the necessity of practical verification of obtained results through implementation of recommended changes by hospitals.

Key words: inventory management, process modelling, hospital logistics.

INTRODUCTION

Pharmacotherapy, or treatment using medicinal products is one of the therapies used as a treatment method in hospitals. Medicinal product - according to the Polish law - is "a substance or mixture of substances presented as having properties for treating or preventing disease in human beings or animals or given in order to make a diagnosis or to restore, improve or modify physiological functions by exerting a pharmacological, immunological or metabolic effect" [Act of 6 September 2001]. Colloquially, medicinal products are called medications, and in this article are used synonymously. According to data from IMS Health sp. z o.o., sales of medicinal products to hospitals in Poland in 2015 was 4,178,267,321 PLN (The values are expressed in net producer prices, according to the IMS methodology) [IMS 2016], and the increase in these expenses over the years is in line with the global trend recorded by the Organisation for Economic Cooperation and Development [OECD 2015]. According

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to estimates, the average hospital in Poland manages approx. 130 thousand medicinal products [Karkowski 2015], and the medications are the second - after wages – cost-intensive element of the hospital operation [Religioni 2016].

Inventory management of medicinal products in the hospital is a very important area of the functioning of the hospital. Also taking into account the aspect related to the need to ensure an appropriate level of patient care, efficient and effective inventory management of medications affects ensuring safety of the patient during hospitalization, as well as outside the hospital [Hałas et al. 2007]. Particularly important from the point of view of medications inventory management and decision-making in the selection of the most rational model of inventory management is reliable data on consumption of individual products. These data are crucial for the provision of proper medicinal products to the patient for whom they were prescribed. Any delay in access to information or incorrect information can pose a serious threat to the health and lives of patients. It is therefore legitimate to state that patient safety is a derivative of efficiency and effectiveness, among others, of the process of inventory management of medicinal products.

This article presents the assumptions of modelling inventory management of medicinal products in hospitals using the methodology to improve the efficiency of the processes described in BPMN 2.0 and using iGrafx software. In the research medicinal product availability in the process of patient treatment was analysed in an innovative way. The emphasis was put on both physical flows of medicinal products as well as on the flow of information regarding product availability and delivery/replenishment time. The latter being most important from the Authors' perspective.

RESEARCH BACKGROUND

The basic condition that enables efficient and effective inventory management of medicinal products in the hospital is the access to information and efficient information system, which is a collection of components that collect and store data, change their content and form, emit data and information and provide feedback to achieve the desired objective [Stair and Reynolds 2009]. Data accuracy is particularly important in the hospital because it allows the correct process of ordering and distribution of medications, which is of great significance from the perspective of treatment and medical service of the patient. Access to reliable data on the level, type and location of inventory of medicines in the hospital depends on many factors influencing the management processes of the movement of medications and patients and related information together with the actions supporting these processes in the hospital [Marasli et al. 2017]. Furthermore, very often the data are required in real time due to the need for the quickest possible response to the patient's needs in terms of pharmacotherapy [Gebicki et al. 2014]. For this reason, it is recommended to use support for the information system management in the form of a computer system, which supports pharmacy and departmental staff in the collection, processing, aggregation and sharing data in electronic form in real time.

From the point of view of improving the process of inventory management of medications in the hospital, the recording and collecting data is not enough by itself. It is also necessary to ensure their acquisition, transmission, processing and sharing [Kuck 2013]. To this end, as part of streamlining the inventory management of medications in the hospital, it is recommended to use mobile solutions and devices. They are a manifestation of the hospital's interest in technical and technological innovation, but above all, they contribute to improving the efficiency of the hospital information system and meeting the specific information needs of individual users through enabling data collection at the process source. Additionally, mobile solutions and devices can help to shorten the duration of steps in the process of inventory management of medicines, i.e. generating a list of deficiencies, ordering, taking delivery, etc.

The implementation of even the most advanced IT system will not exhaust

the possibilities for streamlining the process associated with the medicines inventory management in a hospital, if the data for this system are mainly entered manually, in addition to certain actions being duplicated, which may lead, for example, to simultaneous coexistence of documents in electronic and paper form [Daily et al. 2016]. Therefore, it is reasonable to use automatic data capture techniques – ADC. According to the definition, automatic data capture "means the direct input of data into a computer system or other device controlled by a microprocessor without using the keyboard, using a specific ADC technique (...)" [Fertsch 2006]. Conducted over 20 years ago, the studies have shown that in the case of manual data entry by keyboard 1 error per 100 characters occurs, and when scanning barcodes 1 error per 10 million characters [Puckett 1995].

In the face of a variety of technical and technological solutions in the area of health care, we can observe the trend towards the introduction of uniform methods of communication in order to be able to collect, aggregate and exchange information as effectively and efficiently as possible [Hałas 2012]. Patient safety, which has become a top priority in health care accelerates the pace of implementation of standardized solutions, proven in other industries. Popular for years, internal solutions, also known as private, are giving way to standardized solutions. Meanwhile, the use of such solutions is no longer perceived by the health care entities and patients as a source of competitive advantage of these entities, but as a way of reducing the costs of operation of health care institutions. Therefore, also for the purpose of efficient inventory management of medications in the hospital, it is reasonable to use automatic data capture techniques, based on global GS1 standards, which significantly contribute to the improvement of the area of operation of hospitals in question [Ebel et al. 2012]. This is especially justified with regard to the national and European regulations, due to which the supplies of medicines to hospitals are labelled with GS1 barcodes.

MATERIALS AND METHODS

Activities related to the medicines management modelling process in hospitals can significantly contribute to the selection of the most rational approach to ordering, storage and distribution of medicines. The rationality may be assessed by verifying the legitimacy of the use of appropriate tools and solutions, affecting access to data on the level, type and location of inventories at the hospital. One of the methods of searching for changing points – improvements and preparing for their implementation, is the process analysis [Gabryelczyk, Rakowska 2015, Gawrin, Marcinkowski 2013, Kasprzak 2005]. It helps to understand the key activities of the organization. It helps to define their terms and their characteristics and also gives opportunity to evaluate their responsibilities for realization of each process. [Stajniak 2015]. Centre of Process Excellence in Institute of Logistics and Warehousing has established methodology of business processes optimization, using BPMN 2.0 standard. The aim of the research was to evaluate usefulness of process analysis for the sake of modelling medicinal products inventory management process in hospitals using a methodology based on the BPMN standard concentrated on process efficiency improvement. Process analysis and process mapping was done using the methodology of process modelling in BPMN 2.0 (Business Process Model and Notation) in the iGrafx computer system. BPMN 2.0 is a standard developed by the organization Object Management Group, and its primary purpose is to provide a method for business process description, understandable for persons monitoring processes in a variety of entities, as well as for developers responsible for their technical implementation [Drejewicz 2012]. BPMN 2.0 is ISO/IEC 19510:2013 certified standard.

The research was conducted between January 2015 and December 2015. Patient care process and identification of bottlenecks in non-medical processes regarding medicinal products distribution was the starting point of the whole analysis. A top-down approach used in the research allowed to focus on the whole patient process from bird's eye view in order to identify possible optimization potential

on the ground of logistics in each hospital, focusing on inventory management of medicinal products.

The research aimed to assess the processes related to inventory management of medicinal products, which consisted of the following sub-processes:

a) placing an order with the supplier by the hospital pharmacy, understood as the sequence of actions from the occurrence in the IT system of the demand for certain medications until confirmation by the supplier of readiness to perform the order,
b) acceptance of delivery by the hospital pharmacy, understood as the sequence of actions from the physical occurrence of the delivery in the hospital until the approval of the new levels of medications in the pharmacy,
c) picking medicinal products for departments by the hospital pharmacy, understood as the sequence of actions from the occurrence in the IT system of the demand for certain medications from the department to the release of medications and updating the pharmacy levels,
d) completion and dispensation of drugs to a patient by a nurse on the ward, understood as the sequence of actions from the occurrence in the IT system of the physician's order until confirmation of drug administration in accordance with the order in the IT system.

Each hospital represents a different kind of institution, i.e. a county hospital, a departmental hospital and a prison hospital. The characteristics of the particular entities are presented in Table 1.

Table 1. Characteristics of the hospitals participating in the study
Tabela 1. Charakterystyka szpitali biorących udział w badaniu

	Hospitals involved in the study		
Hospital name used in the test	County hospital	Departmental hospital	Prison hospital
Legal form to hospital	Limited liability company	Independent public health care facility	Health care facility for persons deprived of liberty
Founding body	County Office	Ministry of the Interior	Ministry of Justice
Number of beds	194	200	86
Model of medicinal products distribution	Hospital pharmacy and so-called departmental pharmacies		

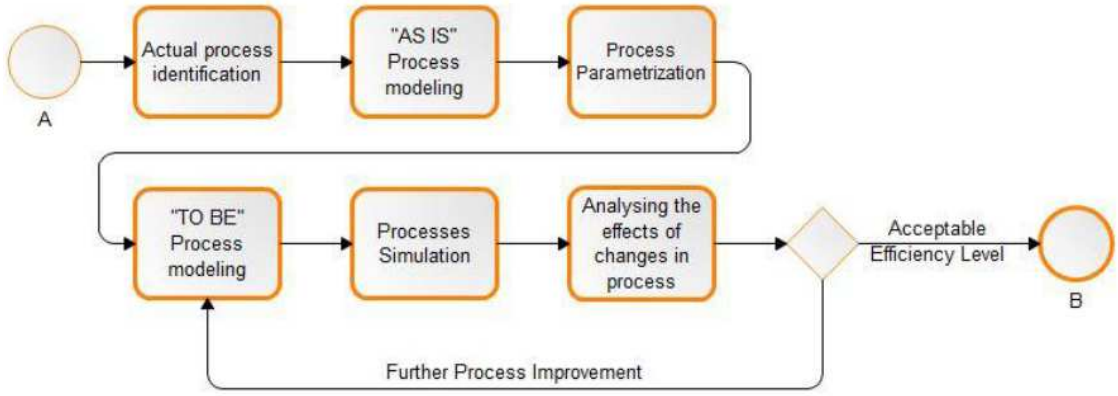

Fig. 1. General overview of the applied methodology
Rys. 1. Ogólna charakterystyka zastosowanej metodyki badawczej

As part of the applied methodology a process approach was used, which assumes a comprehensive identification of business roles, activities and events in the studied subprocesses. Figure 1. present a general overview of the applied methodology.

The above presented general approach was then adopted to hospital environment and included the following steps and activities:

a) process analysis and mapping processes studied in current terms ("AS IS"),
b) identification of the so-called bottlenecks and constraints, having a direct impact on inventory management of medicinal products,
c) verification of the validity of the introduction of pre-defined improvements of the surveyed subprocesses
d) preparation of maps in terms of objectives ("TO BE")
e) parameterization of the developed models in current and target terms ("TO BE") based on time parameters,
f) simulation of waveforms AS IS and TO BE processes and comparative analysis of changes.

The data, on the basis of which the process analysis and process mapping were performed had been obtained through direct interviews with hospital staff: pharmaceutical and nursing personnel. In addition, a review of functionality of IT systems functioning in hospitals was performed. Time parameters adopted in the study were also obtained through direct interview. In order to simulate the processes, analytical models were built for the mapped processes and parameters were entered for all process activities and events. In particular, durations of individual tasks were specified. They were defined mainly by using normal and uniform distribution function within a period of time specified during the interview, and the flow control parameters in the decision gateways as the likelihood of occurrence of a given decision determining further process flow. The reason for the use of the normal distribution is its incidence on the basis of a number of events and phenomena. The normal distribution plays an important role in the statistics and if a value is a sum or an average of many small random factors, then regardless of the distribution of each of these factors, its distribution will be close to normal. For the purposes of standardization of approach in the three studied hospitals, we adopted the average data, in daily terms and in the context of the whole hospital.

RESULTS

As a result of the process analysis, identification was made of the so-called bottlenecks and constraints, which have a direct impact on inventory management of medicinal products in the studied hospitals and method of collection and sharing of data on flow and consumption of medications. The constraints identified were similar in all three hospitals. Therefore, Table 2 shows the consolidated results of the process analysis and the summary of constraints identified in the three hospitals in generalized terms.

Table 2. Constraints identified in the area of inventory management of medicinal products
Tabela 2. Ograniczenia zidentyfikowane w obszarze zarządzania zapasami produktów leczniczych

Hospital organizational unit	**Type of constraints**
Pharmacy	– duplicate documents (both in paper and electronic form) – delay in access to data on the actual level of stocks of medicines in the pharmacy – lack of access to real-time data about the release of medicines to patients in wards – lack of support from IT system as part of operations, i.e. ordering and delivery verification – performing tasks manually and only visual delivery inspection – lack of knowledge about the disbursement of medicines per patient – lack of knowledge about the lot number of the medicine disbursed to the department – entering data on medicines manually to the IT system
Department	– duplicate documents (in both paper and electronic form) – duplicate activities – delay in access to current data about the product – manual entry of patient data to the IT system

A serious drawback of the implemented subprocesses was time delays that threaten effective and efficient inventory management of medicinal products in hospitals to the largest extent. These delays - along with other restrictions - lead to the lack of knowledge in real time on the level, location and type of stocks. This knowledge, in turn, has its important implications in the area of securing relevant products for patients with

simultaneous rational management of inventory.

As part of the study, simulations were carried out of the four examined subprocesses in all three hospitals, both in current and target terms, taking into account the proposed changes. These changes included, among others, use of:

a) integrated Healthcare Information System (HIS),
b) global identification standards for the sake of product identification, e.g. GS1,
c) Automatic Data Capture (ADC) techniques, e.g. barcodes,
d) mobile devices supporting pharmacist and nurses, e.g. medical tablets,
e) standardized electronic documents and electronic information flow,
f) bedside scanning concept.

The aim of the simulation was to demonstrate the quantitative changes by comparing the parameters in both facets in the context of the adopted measures:

a) average service time,
b) average working time.

It is assumed that shortening that time will mean shortening the waiting time for reliable data about the stock of medicinal products in hospitals, resulting on one hand in limitation of drug shortages, but on the other hand, allowing the simultaneous reduction of expired products. Tables 3, 4, 5 and 6 show the results of the simulation. The test measures are presented in minutes. The resulting figures have been rounded to one. Based on the obtained values, the difference has been calculated between the current and the target values, and the indicator result is shown in percentage terms.

Table 3. The simulation results of the process "Placing an order with the supplier by the hospital pharmacy"
Tabela 3. Wyniki symulacji procesu "Złożenie zamówienia u dostawcy przez aptekę szpitalną"

	County hospital			Departmental hospital			Prison hospital		
Measure	"AS IS"	"TO BE"	Change*	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change
Average service time in minutes	63	40	-37%	12	4	-67%	268	240	-11%
Average working time in minutes	31	4	-87%	12	4	-67%	thirty	1	-96%

* In each case, the result was calculated as a percentage of the resulting difference between the duration of the process in "AS IS" terms and "TO BE" during the process in "AS IS" terms. In the case of reducing the duration of the "TO BE" process, the change was marked with a minus sign (-), and in the case of prolongation of the "TO BE" process with a plus sign (+).

The simulation results show that in all three cases shortening service time and working time was reported. The level of change is heavily dependent on the current organization of processes, as well as other activities that were not subject to change. In the case of the average service time, the changed was smallest for the prison hospital, because due to its organization the approach was maintained, according to which it begins with the occurrence of the first order from a department, and ends at 14.00 at the time of grouping all department orders. Work time was shortened most for the prison hospital, because the most labour-intensive activity was eliminated, namely telephone ordering, replacing it with a fully automated and electronic procedure.

Table 4. The simulation results of the process "Acceptance of delivery by the hospital pharmacy"
Tabela 4. Wyniki symulacji procesu "Przyjęcie dostawy przez aptekę szpitalną"

	County hospital			Departmental hospital			Prison hospital		
Measure	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change
Average service time in minutes	53	39	-26%	20	15	-25%	121	58	-52%
Average working time in minutes	52	26	-50%	20	15	-25%	101	58	-43%

The simulation results show clearly that the implementation of the proposed improvements should lead to comparable changes in time for all the studied hospitals. All test parameters are reduced. In the case of the prison hospital service time and working time vary significantly due to the much longer duration of the process. This is mainly due to differences in the number of ordered items that are subject to verification in this process.

Table 5. The simulation results of the process "Completion of medicinal products to the departments by the hospital pharmacy"
Tabela 5. Wyniki symulacji procesu "Kompletacja produktów leczniczych na oddziały przez aptekę szpitalną"

	County hospital			Departmental hospital			Prison hospital		
Measure	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change
Average service time in minutes	19	16	-15%	65	23	-75%	37	22	-40%
Average working time in minutes	15	12	-20%	12	4	-67%	18	3	-83%

As in the first two processes, also another studied process involves shortening both the service time and working time. The biggest changes in the service time can be seen in the case of departmental hospital and slightly lower for the prison hospital. The changes result from the eliminating activities which introduced delays into the process and overlapping steps. The simulation results for the county hospital indicate high process efficiency in the current model, as evidenced by both the duration of the "AS IS" process and the expected level of changes in the improvements.

Table 6. The simulation results of the process "Completion and dispensation of medications to a patient by a nurse on the ward"
Tabela 6. Wyniki symulacji procesu "Kompletacja i dyspensacja produktów leczniczych pacjentowi przez pielęgniarkę na oddziale"

	County hospital			Departmental hospital			Prison hospital		
Measure	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change	"AS IS"	"TO BE"	Change
Average service time in minutes	13	6	-54%	14	4	-71%	12	3	-75%
Average working time in minutes	7	5	-29%	8	3	-63%	12	3	-75%

The simulation results of the last process also demonstrate that the inclusion of the proposed improvements carries significant potential for optimization. The conducted research and especially analytical work have shown that process modelling in the area of the management of medicinal products flow plays a crucial role. In-depth analysis of this process results in positive consequences from the point of view of complex patient care. It makes it possible to unambiguously understand limitations regarding current process organization and outline directions of changes and improvements. Lack of this analysis makes processes ineffective and inefficient despite the availability of technical and technological solutions.

CONCLUSIONS

Inventory management of medicinal products in the hospital is a complex and multi-layered process, also due to the large number of legal regulations in this area. The process analysis led to the identification of bottlenecks, having an impact on the process of inventory management. In addition, the conducted simulations verified the validity of the proposed improvements and demonstrated the ability to reduce the average service time of investigated subprocesses. This in turn may result in improved effectiveness and efficiency of processes related to inventory management

of medicinal products in hospitals. The introduction of improvements can also contribute to improving the transparency of the internal chain of distribution of medicinal products and increase the level of patient care by enabling access to data on the level, type and location of stocks for the purposes of the process of withdrawal of medicinal products, limiting the number of products past shelf date, or limit the number of shortages in products. Not without significance is the fact that the improvements, significantly affecting the shortening of average service time included the use of ADC techniques. This allows the introduction of a mechanism to share data on medicine consumption in real time and confirming information stored in the IT system of the hospital.

The study showed the usefulness of modelling processes related to inventory management of medicinal products in the hospital. The applied research method results in positive consequences from the perspective of a comprehensive approach to managing the internal hospital logistics processes. It allows to clearly understand the limitations and difficulties in the existing processes and to outline directions of changes and improvements. Support for modelling with an appropriate IT tool serving a simulation of the proposed changes, allows for making decisions in scope of setting directions for improvement without their prior implementation. As a result, it is possible to create various models and compare simulation results in order to select the most rational course of a process.

The author recognizes the need for practical verification of the data by implementation of the proposed changes by hospitals. In the opinion of the author, effectiveness and efficiency of implementation of the proposed solutions is highly dependent on the technical, technological and organizational conditions. Obtained research results regarding inventory management of medicinal products are the basis for further detailed research aimed at verifying the effects of simulation conducted within the research process. First of all, performance indicators referring to inventory management of medicinal products should be verified. Moreover, impact of business process modelling on other intrahospital logistics processes shall also be verified and evaluated from the point of view of process efficiency and patient safety.

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MODELOWANIE PROCESU ZARZĄDZANIA ZAPASAMI PRODUKTÓW LECZNICZYCH W SZPITALACH Z WYKORZYSTANIEM METODYKI OPARTEJ O STANDARD BPMN

STRESZCZENIE. **Wstęp:** Jedną z terapii wykorzystywanych w procesie leczenia w szpitalu jest farmakoterapia, czyli leczenie za pomocą produktów leczniczych. Według danych szacunkowych przeciętny szpital w Polsce zarządza ok. 130 tys. produktów leczniczych, a leki stanowią drugi – po wynagrodzeniach – element kosztochłonny funkcjonowania szpital. Biorąc również aspekt związany z koniecznością zapewnienia odpowiedniego poziomu obsługi pacjenta, a w głównej mierze jego bezpieczeństwa, zwłaszcza na gruncie farmakoterapii, zarządzanie zapasami produktów leczniczych w szpitalu stanowi niezwykle istotny obszar funkcjonowania szpitala. Celem artykułu jest przedstawienie założeń modelowania procesu zarządzania zapasami produktów leczniczych w szpitalach z wykorzystaniem metodyki poprawy efektywności procesów opartej o standard BPMN.
Metody: Badanie zostało przeprowadzone w trzech szpitalach na terenie woj. wielkopolskiego w okresie od stycznia 2015 do grudnia 2015. W ramach zastosowanej metodyki posłużono się podejściem procesowym, zakładającym kompleksową identyfikację ról biznesowych, czynności i zdarzeń w badanych procesach. Przedmiotem badania były procesy związane z zarządzaniem zapasami produktów leczniczych szpitalach.

Wyniki: W artykule opisano sposób modelowania procesu zarządzania zapasami produktów leczniczych w szpitalach z wykorzystaniem metodyki opartej o standard BPMN. Autorzy przedstawiają zastosowanie podejścia procesowego w badaniu problemu związanego z racjonalizacją procesu zarządzania zapasami, ze szczególnym zwróceniem uwagi na możliwość uzyskania dostępu w czasie rzeczywistym do danych na temat: rodzaju, lokalizacji i poziomu produktów leczniczych.
Wnioski: Zarządzanie zapasami produktów leczniczych w szpitalu jest procesem złożonym i wielowątkowym, również z uwagi na dużą liczbę regulacji prawnym w przedmiotowym obszarze. Przeprowadzone badania wykazały przydatność podejścia procesowego z wykorzystaniem metodyki opartej o standard BPMN w zakresie racjonalizacji zarządzania zapasami produktów leczniczych. Autorzy dostrzegają konieczność praktycznej weryfikacji uzyskanych danych na drodze implementacji proponowanych zmian przez szpitale.

Słowa kluczowe: zarządzanie zapasami, modelowanie procesów, logistyka szpitali

MODELLIERUNG DES PROZESSES FÜR DIE BESTANDSFÜHRUNG VON ARZNEIMITTELN IN KRANKENHÄUSERN MIT ANWENDUNG DER AN DEN BPMN-STANDARD GESTÜTZTEN METHODIK

ZUSAMMENFASSUNG. Einleitung: Eine der im Heilungsprozess in Krankenhäusern angewendeten Therapien ist die Pharmakotherapie, d.h. die Behandlung mithilfe von Heilprodukten. Laut den Schätzungen verwaltet das durchschnittliche Krankenhaus in Polen ca. 130 Tausend Heilprodukte, wobei die Arzneimittel das zweitgrößte – nach Gehältern – kostenintensive Element bei der Betätigung von Krankenhäusern ausmachen. Angesichts der Notwendigkeit der Gewährleistung eines entsprechenden Niveaus beim Patientenservice, insbesondere in Bezug auf die Sicherheit des Patienten im Bereich der Pharmakotherapie, stellt die Bestandsführung von Heilprodukten im Krankenhaus eine sehr relevante Sphäre der Krankenhaus-Betätigung dar. Das Ziel des Artikels ist es, die Annahmen für die Modellierung des Prozesses für die Bestandsführung von Arzneimitteln in Krankenhäusern mit Anwendung der an den BPMN-Standard gestützten Methodik zur Verbesserung von Prozessen zu projizieren.
Methoden: Die betreffenden Untersuchungen wurden in 3 in Wielkopolska (Großpolen) gelegenen Krankenhäusern im Zeitraum vom Januar 2015 bis zum Dezember 2015 durchgeführt. Im Rahmen der angewandten Methodik hat man ein prozessmäßiges Herangehen, das eine komplexe Identifizierung von Business-Rollen, Tätigkeiten und Ereignissen innerhalb der untersuchten Prozesse annahm, in Anspruch genommen. Zum Kernpunkt der Erforschung wurden die mit der Bestandsführung von Heilprodukten in Krankenhäusern verbundenen Prozesse.
Ergebnisse: Im Artikel wurde die Art und Weise der Modellierung des Prozesses der Bestandsführung von Heilprodukten in Krankenhäusern mit der Anwendung der an den BPMN-Standard gestützten Methodik dargestellt. Die Autoren projizieren die Anwendung des prozessmäßigen Herangehens an die Lösung des Problems, das mit einer Rationalisierung des Bestandsführungsprozesses in besonderer Wahrnehmung der Möglichkeit eines Zugriffs auf die folgenden Daten in Echtzeit: Art, Verortung und Niveau der Heilprodukte, verbunden ist.
Fazit: Die Bestandsführung von Heilprodukten in Krankenhäusern stellt einen komplexen und vielfältigen Prozess dar, auch angesichts der Vielzahl gesetzlicher Regelungen auf dem betreffenden Gebiet. Die durchgeführten Forschungen zeigten die Anwendbarkeit des prozessmäßigen Herangehens mit der Inanspruchnahme der an den BPMN-Standard gestützten Methodik im Bereich der Rationalisierung der Bestandsführung von Arzneimitteln auf. Die Autoren nehmen die Notwendigkeit einer praktischen Verifizierung der erzielten Ergebnisse mittels der Implementierung der vorgeschlagenen Veränderungen seitens der daran interessierten Krankenhäuser wahr.

Codewörter: Bestandsführung, Modellierung von Prozessen, Krankenhaus-Logistik

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