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# ENHANCING PATIENT RESPONSE TIME AND HOSPITAL EFFICIENCY. EVIDENCE FROM THE WIELKOPOLSKA REGION (POLAND)

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**ABSTRACT.** The research was conducted in three hospitals in the Wielkopolska Region (Poland) with the aim at verifying how implementation of the Automatic Data Capture (ADC) techniques and global GS1 standards in the field of management of medicinal products flow in hospitals can help improve patient response time, quality of healthcare services and hospital efficiency. A special method was used, based on the Business Process Modelling Notation – BPMN, supported with the iGrafx software. The results of the research show that implementation of the ADC techniques and global GS1 standards in selected areas in a hospital can possibly lead to significant qualitative and quantitative changes.

***JEL Classification:*** L3, L8

***Keywords***: hospital efficiency, patient response time, global GS1 standards, Automatic Data Capture, electronic documents, quality of services, patients' safety.

## Introduction

The healthcare sector, and especially the way hospital entities offering medical services operate, has been undergoing significant changes in recent years. These changes refer both to the way medical services are performed but also to the methods of management of healthcare units (Durlik, 2008; Trela, 2014; Karkowski, 2015). Moreover, in the healthcare sector one can notice both an aspiration to provide patients with the highest quality services and increasing expectations of patients who are more and more conscious of their rights (Lewandowski, 2008; Marcinów and Olejniczak, 2011; Moczydłowska *et al.*, 2014; Zieliński, 2015). Multidimensional changes in the field of the healthcare sector led healthcare managers to make various decisions aimed at verifying their current management methods. Not only do they want to administer a hospital entity but also to manage it with the use of methods and strategies that have been successfully validated in other sectors (Lewandowski, 2010, p. 160; Bloom *et al.*, 2015; Ghanem, 2015).

Despite a great technical and technological progress (Healthline News, 2013), the results of various studies and research show that patient safety is in danger due to ineffective and inefficient management of medicinal products flow in hospitals. Difficulties and challenges regarding quick and automated access to reliable data for the sake of more rapid reaction to patient's needs as well as better patient safety are definitely the reasons for such

a situation. In many countries around the world research has been carried out regarding patient care in hospitals. In countries such as USA, UK or New Zealand (HDMA, 2006, p. 3; The National Academies Press, 2006, p. 105; Department of Health, 2007, p. 5; Jones, 2009, p. 1; Metzger *et al.*, 2010 p. 4; GS1, 2010, p. 15) the research in the field of management of medicinal products flow in the context of patient care showed that patient safety – inside and outside a hospital – is very often endangered. *Chart 1* shows the results of American research in that area. Although in Polish literature there is no detailed data regarding this issue due to the fact that it is not reported, it can be assumed that the results would be similar. Additionally, it has been proved that pharmacotherapy is the most error-burdened therapy (Marczewska, 2010). The consequences of such a situation can be observed both with respect to decreasing patient safety as well as on the financial ground.

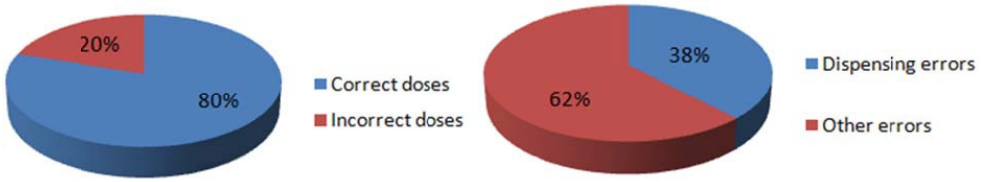


Chart 1. Results of American research regarding number of medication errors
*Source*: Own elaboration based on (HDMA, 2006, p. 3).

In Poland, within activities focused on improving quality of medical services, there are no initiatives aimed at defining guidelines and harmonised solutions in the field of logistics in hospitals. Poor information infrastructure in Polish hospitals and lack of interoperability between various ICT solutions are also a problem. Research shows that healthcare entities are not able to follow the speed of worldwide changes in the area in question (CSIOZ, 2014; Kautsch, 2015, p. 566). Low level of implementation of global standards within eHealth is an additional problem. *Chart 2* depicts the scale of this problem.

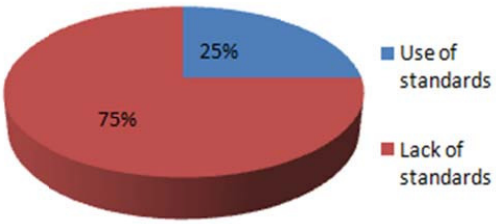


Chart 2. Number of entities using and not using standards in the area of eHealth
*Source*: CSIOZ, 2014.

There is also a common lack of use of the global GS1 standards (e.g. barcodes and electronic documents) in the field of identification, capture and exchange of data regarding objects and locations. These standards have been used successfully in other industries, including hospital industry in other countries, for over 40 years, helping their users obtain

different benefits (McKinsey&Company, 2012). In Poland, use of these standards is legally required with reference to medicinal products that are available on the Polish market. Nevertheless, the use of these standards in hospitals is of a marginal character.

The level of ICT advancement varies from hospital to hospital and in the majority of cases it is not sufficient from the point of view of automatisation and electronisation of particular processes and activities (Rębisz, 2014). There is still a group of hospitals – especially small ones – without an IT support. Some of hospitals use IT systems disabling data exchange with other entities (Kielar, 2013, p. 58). In summary, the identified limitations and difficulties disabling effective and efficient flow of medicinal products in the context of patient care and patient safety may be divided according to seven wastes (Bicheno and Holweg, 2009) as presented in *Table 1*. The problems listed below impact patient response time and hospital efficiency in a negative way.

Table 1. Main limitations in hospitals from logistics point of view according to seven wastes

| Name of waste | Identified problem within logistics in hospitals |
|---|---|
| 1. waiting | – delay in the access to current data regarding real inventory level and location |
| 2. transportation | – shift of products between wards |
| 3. motion | – necessity to return to doctor's room to update doctor's orders |
| 4. over-processing | – documents both in paper and electronic form |
| 5. inventory | – lack of real-time knowledge regarding inventory level |
| 6. defects | – errors regarding product picking and identification control |
| 7. over-production | – double / manual activities |

*Source*: own.

The aim of this paper is to present the results of research conducted in three hospitals in the Wielkopolska Region. The research was aimed at verifying how implementation of the ADC techniques and global GS1 standards in the field of management of medicinal products flow in hospitals can help improve patient response time, quality of healthcare services and hospital efficiency. In order to conduct the research a special method was used, based on the Business Process Modelling Notation – BPMN, supported with the *iGrafx* software. Process modelling is becoming more and more popular in the field of hospital management. However, no similar research has been conducted so far, to the best of our knowledge. The results of the simulation show that implementation of the ADC techniques and global GS1 standards within management of medicinal products flow in a hospital can possibly lead to significant qualitative and quantitative changes.

## 1. Research tool and method

The research took place between January 2015 and December 2015 and included the participation of three hospitals located in the Wielkopolska Region. *Table 2* presents main characteristics of the hospitals.

Table 2. Main characteristics of the hospitals participating in the research project

| | Hospitals participating in the research project | | |
|---|---|---|---|
| Reference number for the sake of this article | 1 | 2 | 3 |
| Type | Ltd. | Public healthcare entity | Healthcare entity for imprisoned people |
| Founder | District Office | Ministry of Internal Affairs | Ministry of Justice |
| Number of beds | 194 | 200 | 86 |
| Number of wards | 15 | 10 | 3 |
| IT system | yes | yes | yes |

*Source*: own.

In order to conduct the research, a special method was used, based on the Business Process Modelling Notation – BPMN, supported with the *iGrafx* software. *BPMN 2.0* (Business Process Modelling Notation) is currently the most popular tool used for business process description, possible to be used in any industry. *iGrafx* software makes it possible to parameterize, calibrate and simulate processes in order to:

- *verify* various models,
- *justify* any changes,
- *estimate* consequences.

The research method included:

- development of a reference model regarding medicinal products flow including legal, social, economic and logistics issues,
- operational analysis in three hospitals:
  - process analysis and mapping of the following processes: patient flow, flow of medicinal products, flow of documents,
  - identification and analysis of any other logistics processes influencing the flow of medicinal products,
  - analysis of identification systems of patients and medicinal products,
  - analysis of legal and organizational requirements regarding processes realized in hospitals,
  - identification and analysis of pre-defined general problems.
- synthesis of requirements in the field of effectiveness and efficiency of particular processes,
- development of improvements within particular processes including the assumptions of the reference model.

Process analysis undertaken included the following steps:

- visiting hospitals for identifying and understanding processes,
- drawing a general process,
- meeting with operational people,
- drawing operational maps of 'AS IS' processes,
- parameterization of the process and finding bottlenecks,
- developing of 'TO BE' maps including recommendations and agreed changes,
- simulating of 'TO BE' maps.

In order to enhance patients' safety and hospital efficiency, a special reference model has been developed. Its basic assumptions include the use of the global GS1 standards as well as Automatic Data Capture Techniques. Moreover, all relevant legal requirements have also

been taken into account. The justification for these assumptions is reflected in the results of various research that showed (McKinsey&Company, 2012) major benefits possible to be obtained as a result of implementing standard-based ADC techniques in the healthcare industry, e.g.:

- correct and quick identification of patients and medicinal products,
- ability to automatically track and trace the flow of patients and medicinal products,
- automated process medicinal products ordering,
- better inventory management process.

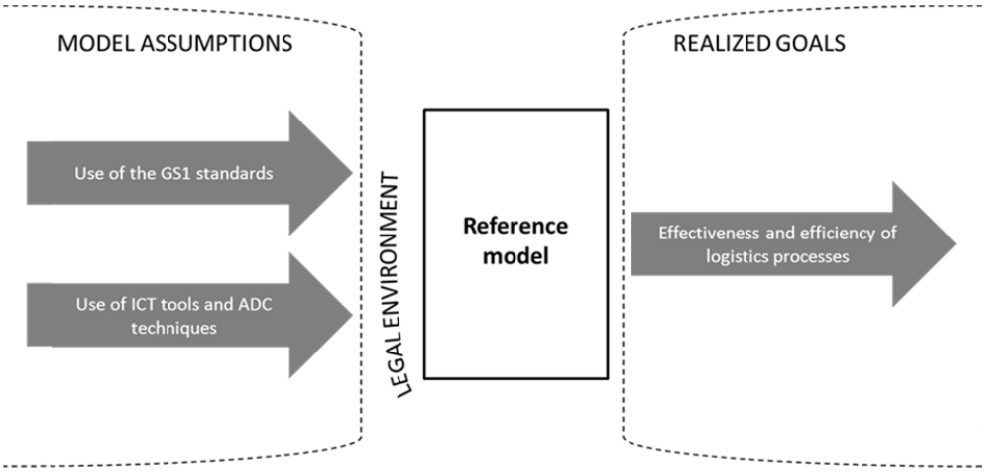


Chart 1. Assumptions of the reference model
*Source*: own.

ADC techniques can be used in many processes, starting from patient identification methods, registering accurate data regarding medicinal products and other healthcare products as well as product traceability throughout the whole supply chain (Hałas, 2012). Nowadays nobody questions the need to use unified and harmonized approach, independent of IT systems. Standardized way of identification and communication in the supply chain is a very important factor in the management of the flow of objects and information in any industry.

Moreover, the process of globalization and internationalization being observed for a number of years in the healthcare industry justifies the use of global standards as well as solutions that has been successfully used in many areas for years. Global standards that are independent of any technology help achieve many benefits, e.g. process efficiency and effectiveness as well as patient safety. The use of ADC techniques in turn makes it possible to eliminate the sources of medication errors, e.g. the human factor. The developed reference model therefore concentrates on standard-related issues as well as ADC techniques and mobile solutions.

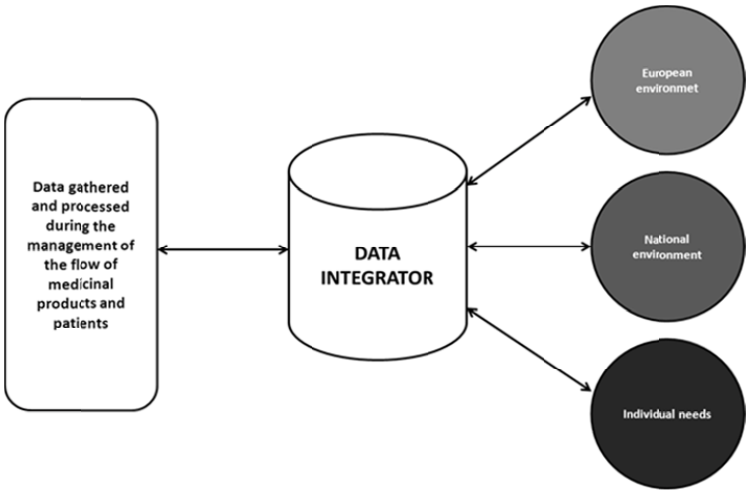


Chart 2. Reference model concept
*Source*: own.

The assumptions of the reference model are as follows:

- use of an integrated IT system,
- use of mobile devices (tablets, terminals, scanners),
- use of unique identification of hospital staff and medicinal products in accordance with the global GS1 standards,
- implementation of patient identification methods based on a national number in a machine readable format,
- compliance with legal requirements,
- implementation of additional modules, e.g. e-Prescription, product authentication, etc.,
- implementation of standardized electronic documents and electronic information flow,
- implementation of bedside scanning concept.

The most important element integrating all standards in the reference model is the uniform way of data entry, interchanged between users in the form of barcodes and Electronic Data Interchange, e.g. EDI. Patients and medicinal products are identified with GS1 standard identifiers presented both in a human and machine readable format. Thanks to such a solution, data referring to individual identified objects can be shared by various users. This means that data that is entered into the system the moment an event takes place, will be available to all users of this system. GS1 identifiers are non-significant identifiers, being keys to any additional information – relevant from the view of logistics – stored in the IT. This way access to data is protected which is extremely important from the point of view of personal data protection. Electronic Data Interchange helps to exchange standard business documents between an IT system of the hospital and wholesaler. This is aimed at limiting human interventions and letting medical staff concentrate on their core duties instead of administrative functions (GS1 Polska, 2000).

The reference model anticipates some important activities, among which the following play a leading role:

- relevant documents are generated automatically and kept in an electronic form, e.g. in the IT system and they are referred to or updated whenever it's needed and justified,

- hospital pharmacy places an order on the basis of an automatically generated message from the IT system and on the similar basis the delivery is checked by means of barcode scanning,
- orders from different wards are collected automatically on the basis of information regarding recommended or dispensed medicinal products,
- products' barcodes are scanned before dispensing to a patient in order to check that the right patients get the right drug,
- products are tracked and traced thanks to a correct link of information in the IT system, e.g. GS1 identifier in a barcode format and information about the delivery sent in an EDI message,
- information about medicinal products dispensed to a patient is stored in his/her personal record, ensuring patient safety and access to historical data whenever its needed.

## 2. Findings of the research

In the research, among others, the following processes were analysed:

- *placement of an order with a supplier*, understood as a sequence of activities from the moment when information about demand for particular medicinal products appears in the IT system until the moment the supplier confirms the readiness to realize the demand,
- *patient order picking and medicinal product dispensation*, understood as a sequence of activities from the moment patient order appears in the IT system until the moment a confirmation of medicinal products dispensation is registered in this system.

Measures that were taken into consideration include:

- *average service time*, understood as time needed to perform all physical activities as well as waiting time,
- *average labour time*, understood as time needed to perform all physical activities.

On the basis of obtained values *in minutes*, the difference between current and target time was calculated. Then, the result was calculated as *percent of share* of the difference in „AS IS" time.

The results of the simulation show that implementation of the ADC techniques and global GS1 standards within logistics management in a hospital can possibly lead to significant qualitative and quantitative changes. As a consequence, particular improvements have been defined and results of their implementation have been simulated with respect to time spent on different activities. *Table 3* shows the results of the simulations of both 'AS IS' and 'TO BE' models regarding placement of an order with a supplier.

Table 3. Results of simulations regarding placement of an order with a supplier (in minutes)

| | Hospital 1 | | | Hospital 2 | | | Hospital 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Measure | „AS IS" | „TO BE" | Difference | „AS IS" | „TO BE" | Difference | „AS IS" | „TO BE" | Difference |
| Average service time | 63 | 40 | -37% | 12 | 4 | -67% | 268 | 240 | -11% |
| Average labour time | 31 | 4 | -87% | 12 | 4 | -67% | 30 | 1 | -96% |

*Source*: own.

*Table 4* shows the results of the simulations of both 'AS IS' and 'TO BE' models regarding patient order picking and medicinal product dispensation.

Table 4. Results of simulations regarding patient order picking and medicinal product dispensation

| | Hospital 1 | | | Hospital 2 | | | Hospital 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Measure | „AS IS" | „TO BE" | Difference | „AS IS" | „TO BE" | Difference | „AS IS" | „TO BE" | Difference |
| Average service time | 13 | 6 | -54% | 14 | 4 | -71% | 12 | 3 | -75% |
| Average labour time | 7 | 5 | -29% | 8 | 3 | -63% | 12 | 3 | -75% |

*Source*: own.

As a result of simulation of implementation effects of the reference model, possibility of reducing service time and labour time has been proved. This is mainly due to implementation of the ADC techniques and elimination of manual and double activities. As a consequence patient response time can be cut and quality of patient care can be improved. Moreover, the reduction of time is also important from the perspective of pharmaceutical and nursing staff. Thanks to streamlining of these two processes the staff can concentrate on their main duties instead of administrative issues of little value from patient's point of view.

The research also proved that other consequences are possible, especially in the field of better patient safety and nursing staff work comfort. This can be achieved thanks to a mechanism excluding possible medication errors. Implementation of the ADC techniques provides an extra verification of medicinal products to be dispensed by means of the so-called bedside scanning. Better visibility of the internal supply chain – thanks to real-time access to reliable data – chain will contribute to a quicker knowledge regarding inventory level, type and location, reduction of any redundant inventory level as well as support in the field of product traceability for the sake of recall. Analysis of trends in the field of development of various solutions based on the GS1 standards, both existing and future ones, shows that including these standards will contribute to better patient safety thanks to more efficient medicinal products traceability and identification of location of medicinal products.

## Conclusions

Each year healthcare cost becomes higher and higher and it may be assumed that in coming years this raise will be more rapid. Additionally, a very complex character of the healthcare supply chain nowadays supports dissemination and implementation of standards solutions based on Automatic Data Capture techniques. It has been proved that these techniques in connection with the global standards play an important and significant role from the point of view of patient response time and also hospital efficiency.

Use of technical and technological achievements as well as the global GS1 standards in the field of medicinal products flow for the sake of identification and real-time data capture and share gives opportunities to improve patient response time, patients' safety as well as hospital efficiency. Such an approach contributes to unification of methods regarding real-time process events registration that helps both pharmaceutical and nursing staff perform their everyday duties. The conducted research and interviews with hospital staff have shown increasing confidence – both among management and nurse staff – in the necessity of implementation of the recommended solutions. It means that these improvements are not

perceived as the first step to employment reduction but as a real support in the area of patient care.

The results of the research may also help hospitals to develop solutions regarding medicinal products flow management aimed at meeting patient expectations as well as reducing the level of scepticism regarding quality of medical services. Introduction of standardization in the field of process management – the field that is seemingly invisible for patients – will help to improve the quality of patient treatment and medical services. Improvement of this sphere of hospitals' activities and implementation of similar process logic will also contribute to other benefits, e.g. streamlining of medical services planning and consumption of specialized medical equipment as well as optimization of staff labour time.

Hospitals, being as a rule organizations of non-business character, analyse more often ways of rationalizing their activities with respect to financial issues as, very frequently, such an approach enables them to increase efficiency of processes they carry out. 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.

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