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THE USE OF BIG DATA RESOURCES IN PATIENT EXPERIENCE MANAGEMENT

Abstract: The aim of the paper is to present opportunities for the use of patient experience management of selected Big Data resources generated by health service stakeholders. The data collected by health service entities often meet conditions of Big Data definition. These are Big Data resources, with substantial variability and varied structure, containing much useful information. The use of analytical Big Data methods in patient experience management should have a positive impact on quality and efficiency of services provided by the health care entities.

Keywords: Big Data, management of healthcare, patient experience.

WYKORZYSTANIE ZASOBÓW BIG DATA DO ZARZĄDZANIA PACJENTAMI

Streszczenie: Celem artykułu jest przedstawienie możliwości wykorzystania zarządzania przypadkami medycznymi pacjenta generowanymi przez interesariuszy służby zdrowia przy wykorzystaniu wybranych narzędzi Big Data. Dane gromadzone przez podmioty służby zdrowia często spełniają warunki wystarczające do zaklasyfikowania je jako Big Data. Są to zasoby o znacznej zmienności i zróżnicowanej strukturze, zawierające wiele użytecznych informacji na temat pacjentów. Zastosowanie analitycznych metod Big Data w zarządzaniu przypadkami pacjentów powinno mieć pozytywny wpływ na jakość i efektywność usług świadczonych przez podmioty służby zdrowia.

Słowa kluczowe: Big Data, zarządzanie służbą zdrowia, doświadczenia pacjenta.

1. Introduction

According to social expectations, health care entities should provide medical services and ensure the highest possible quality of these services while maintaining adequate effectiveness and economic autonomy. Health care services belong to the group of professional services. Service providers should have substantial qualifications and adequate level of knowledge, experience and be eligible to perform this profession¹. A critical point is trust with respect to the service-provider. This results from a substantial knowledge asymmetry between a patient and doctor and fact that health is one of the greatest values for people. Trust is a sociological category and depends on certain subjective factors (Boczkowski, 2007). It is the component of a broader concept: patient experience. With the development of consumer society and the patient habits and expectations concerning the contemporary culture of providing services, health-providing entities are attempting to manage patient experience more and more often and to increasingly broad extent.

Patient experience management requires access to specific patient data. This concerns in particular decision-making processes connected with planning and implementation of management processes and evaluation of their effectiveness. Access to management data, acquisition and collecting the data and their efficient analysis always involves certain costs. More and more data in health care are generated and collected automatically during health care processes in the electronic form and, after adjustment, can be used for managerial purposes. A substantial part of the data generated in health protection can be considered as Big Data.

However, there is no universal and generally accepted definition of Big Data in the literature. First of them defined Big Data as data resources that meet the 3V criterion i.e. Volume, Velocity and Variety (Gandomi, Haider, 2015). Other authors have added additional Vs such as Veracity and Value.

Big Data are complex and huge resources of data of various types, with different level of structure and various formats. TechAmerica Foundation defines Big Data as *a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information* (TechAmerica Foundation's Federal Big Data Commission, 2012).

Effective use of medical resources of Big Data is becoming one of the most important but difficult tasks for health care managers. This concerns not only the most of the health care entities but also other stakeholders, including patients. The expected benefits include:

- easier access to sources of useful knowledge for doctors, managers in health service entities, payers and other organizations connected with health care,

¹ The control of the level of qualifications and eligibility to perform a profession is often controlled by state authorities and labour governments.

- increased level of qualifications of medical personnel,
- increased knowledge of health and prevention among patients,
- increased importance of patient (consumer) experience,
- better user of other health service resources.

The expected benefits can be related, to different extent (directly or indirectly), to the effects of patient experience management.

2. Specific nature of economy of experiences in health care

Quality and effectiveness of operation of health care entities can be analysed from two perspectives. The main perspective concerns technological advancement i.e.:

- ability and competencies of health care employees,
- organizational systems and procedures, availability and quality of medical services,
- access to advanced diagnostic and therapeutic equipment,
- effective financing of health care services.

The second perspective concerns subjective experience and patient expectations. From this subjective standpoint, quality concerns the most direct experiences, perception of illness, evaluation of treatment, experiences connected with contacts with health care employees and other organizations of health care. It is necessary to maintain adequate balance of these two dimensions with consideration for the increase in importance of the "soft" perspective with the development of modern civilization and enrichment of society.

Patient experience fits a much broader concept: experience economy. The concept of experience economy emerged at the end of the last century. From the standpoint of management sciences, experience marketing is very important, being a natural consequence of market changes and processes, with consumer placed at the core of interest. Consumer experiences, feelings and opinions should be the basis for creation of the strategy of enterprises operation in the market. The aim of experience marketing is to build ties based on strong emotions between a consumer and the enterprise through experiences and sensations of the consumer.

C. Gentile, N. Spiller, G. Noci claim that *the Customer Experience originates from a set of interactions between a customer and a product, a company, or part of its organization, which provoke a reaction. This experience is strictly personal and implies the customer's involvement at different levels (rational, emotional, sensorial physical and spiritual)* (Gentile, Spiller, Noci, 2007). The US Agency for Healthcare Research and Quality (AHRQ, 2018) defines *patient experience* as follows: *Patient experience encompasses the range of interactions that patients have with the health care system, including their care from health plans, and from doctors, nurses, and staff in hospitals, physician practices, and other health*

care facilities. As an integral component of health care quality, patient experience includes several aspects of health care delivery that patients value highly when they seek and receive care, such as getting timely appointments, easy access to information, and good communication with health care providers.

The Beryl Institute defines the experience as: *the sum of all interactions, shaped by an organization's culture, that influence patient perceptions across the continuum of care* (Boulding, Glickman, Manary, et al., 2011).

The concept of *patient experience* is often used interchangeably with *patient satisfaction*. The basic difference lies in that satisfaction is connected with meeting expectations, which can be different in different patients.

Patient management processes can be performed within specific areas of activity. The model proposed by B. Schmitt for strategic modules of customer experience can be used in this case. It is composed of five dimensions presented in the Table 1 (Schmitt, 1999).

Table 1.

Dimensions of customer experience in the model designed by B. Schmitt

Module	Consumer Experience
Sense (Sensual Experience)	Experiences for 5 senses
Feel (Emotional Experience)	Experiences for feelings
Think (Intellectual Experience)	Intellectual experiences for cognitive functions
Act (Behavioural Experience)	Experiences for behaviours, physical activities
Relate (Relationally Experience)	Experiences for social groups, interaction

Adapted from: "Experiential Marketing" by B. Schmitt. Copyright Journal of Marketing Management.

In order to improve and develop each module, one should use properly chosen analytical tools that use adequate types of medical Big Data resources and attempt to use them effectively.

Some researchers argue that there is no significant and direct correlation between patient experience and quality of health care services and overall effectiveness of health care entities. However, patient experience should be taken into account in general methodology of measurement of quality and effectiveness of operation of health care entities (AHRQ, 2018).

3. Big Data resources generated in health care

Contemporary business organizations effectively use Big Data resources for e.g. identification of patterns of behaviours of consumers in order to develop innovative services and business solutions. The leading sectors in this field include banking and retail commerce. Increasingly more popular methods of Big Data analytics are connected with the development of other related technologies and new data sources. These include, in addition to other conventional data sources that collect medical records, data from diagnostic and clinical

examinations, indices of the effectiveness of a specific medicine, social platforms, telemedicine, systems such as Internet of Things, various (often automated, remote and mobile) sensors for measurement of health parameters of a patient.

Potential areas of collecting and acquisition of Big Data connected with health care are presented in Figure 1. Typology of the types of data is presented on the left. The criterion for this division is contents of individual types of data. The right side illustrates sources of data located² in most cases in organizations involved in health care. Extended health care is implemented in three main areas (Isaac Cano, Tenyi, Vela et al., 2017):

- informal care,
- health care,
- biomedical research.

Informal care concerns activities of prevention and so-called healthy lifestyles supported by social media. It consists in independent search and utilization of patient's knowledge about health-related topics available in Internet sources.

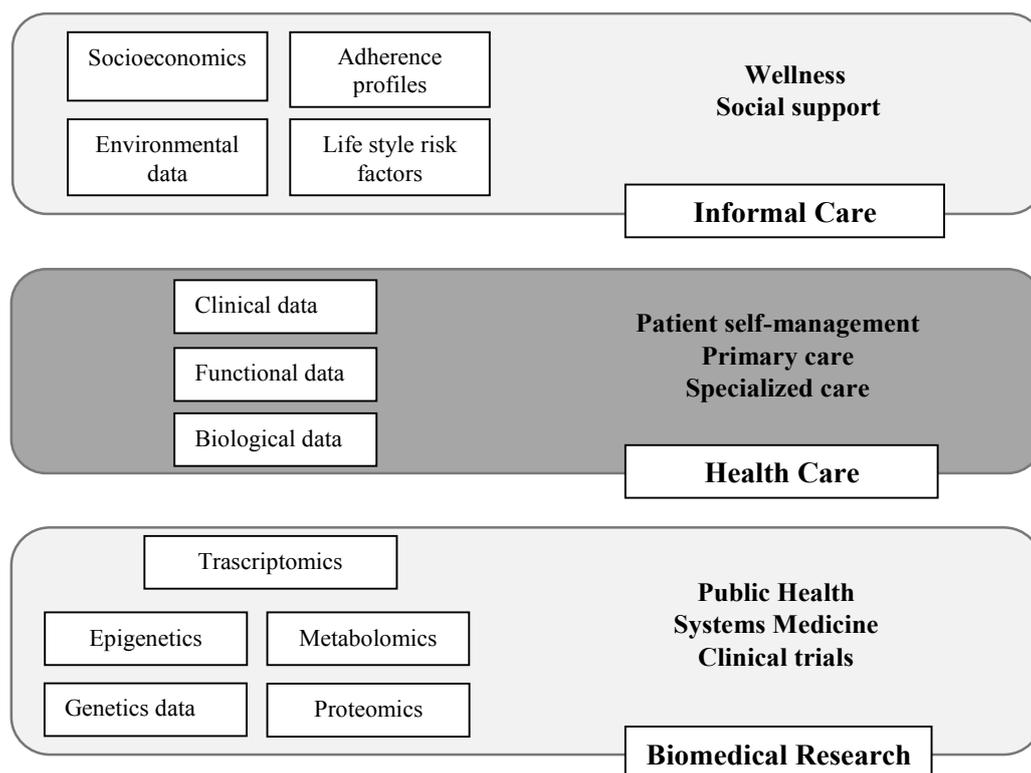


Figure 1. Potential areas of collecting and acquisition of Big Data. Adapted from: “Perspectives on Big Data applications of health information” by I. Cano, A. Tenyi, E. Vela, F. Miralles, J. Roca. Copyright 2017 by Current Opinion in Systems Biology.

Basic areas of interest of potential customers include data concerning risk factors in diseases of affluence related to lifestyles such as obesity, no physical activity, unhealthy diets, smoking, alcohol abuse, high blood pressure, high cholesterol levels etc. The second area of

² Collecting, storage and partial processing in the structure of specific organizations.

interest is the environment people live in. This concerns not only the physical environment (air, food, conditions of working and relax, conditions of safe sport activity) but also social and cultural surroundings and their effect on human health (e.g. addiction to computer games, social media etc.). The other area is various socio-economic data concerning consumer behaviours within health prevention. These data are useful for consumers, suppliers and service-providers.

Health care concerns situations where a patient is convinced that he or she is ill. In the case of illnesses which are not dangerous (colds, indigestion, tiny cuts and bruises), patient use their own remedies, often based on the information from social media and medical popular science portals. With more serious illnesses, patients use basic health care, specialized care or hospital treatment. Potential Big Data sources are electronic medical documentation concerning medical processes, including images and other diagnostic data, data collected from various sensors that measure physiological parameters, data of economic and statistic character (often collected to orders of such stakeholders as payers, state institutions interested in health care etc.)

The area of *biomedical research* involves scientific and research medicine. It involves individual fields of medical sciences and the related sources of data concerning scientific research. This concerns not only medical knowledge contained in databases of medical scientific publications available in the electronic version but also the access to the results of epidemiological, clinical and statistic Big Data examinations.

The use of specific analytical methods and medical Big Data resources should improve the efficiency of management of health care entities, also in the area of patient experience management.

4. Discussion

Effective use of Big Data resources in patient experience management is possible only in selected areas. This results from the specific nature of Big Data and methods to process them. For example, it is difficult to use the methods to analyse Big Data sources in case of direct communication and creation of positive relations between patients and doctors, with substantial role played by authority, doctor's charisma, body language etc. However, one can use the achievements of the scientific data where Big Data are used as a source of data for the research aimed to improve communication between doctors and patients within the so-called narrative medicine. (Fioretti, Mazzocco, Riva, et al., 2016).

Two mainstreams of patient experience management can be emphasized. The first is the independent management of patient's own experience. It includes collecting data, analysis and use of patient's own experience. Based on the examinations conducted by (Jelonek, 2013), the

information concerning health that is searched by Internet users is data about medical entities and doctors. The second is information about illness and treatment methods, followed by information about healthy lifestyles and healthy diets.

Literature analysis performed by P. Liu, S. Currie and J. Adamyk-Simpson led the researchers to the conclusion that most of the studies concerning the measurement of patient experience have been based on time-limited interviews with patients, opinions and sensations of medical personnel and other consultations with experts connected with health care. Little research has been done into the patient's point of view, i.e. treating patients as partners with adequate large and active participation in identification of e.g. methods of patient experience measurement (Liu, Currie, Adamyk-Simpson, 2018). Based on the examinations, they determined major areas of patient experience (patient perspective – areas of interest).

- availability of services,
- humanitarian treatment by personnel,
- qualifications, skills and knowledge of medical personnel,
- patient's engagement in the process of providing services,
- quality of communication,
- individual treatment,
- continuation of medical care in the future.

The presented aspects of patient experience can be considered as expectations organized according to the criteria of significance and priority to patients. Independent building experience by patients is likely to be achieved more or less consciously according to the above mentioned criteria. Patient experience management by all stakeholders of health care should take into consideration the above patients' expectations. Individual stakeholders can be guided by various reasons, can have various opportunities for meeting the expectations and aims of patient experience management. Effects of these activities can be also varied, especially from the standpoint of patient.

Independent building of patient experience consists in conscious activation of individual components of this experience (e.g. dimensions of Schmitt's model). Certain aspects of the model require a direct contact of the patient with the doctor, health care entity and remaining in the place of service providing. This concerns in particular the aspects which are sensual, emotional and partially connected with creation of relations (e.g. face-to-face contacts). Behavioural and intellectual-cognitive dimensions of the experience can be developed in many ways. Obviously, direct contact and "on the spot" observation of e.g. functioning of the medical entity is of substantial practical importance. Contemporary development of information technology opens up, however, new opportunities for building experience in intellectual-cognitive and behavioural areas. According to the idea of Web 2.0, the use of network resources allows for a cheap and fast access to information, reduced asymmetry between patient and doctor, reduced level of stress connected with the lack of knowledge.

Patient's participation in the processes of diagnosis and treatment is becoming easier. The patients are being empowered. Patient can somehow become a doctor's partner, becoming a prosumer. Patient can actively and directly influence the most of elements that form his or her experience. The exceptions include the components that build experience but are beyond the patient's influence, such as public financing of services, legal regulations concerning health care, technological infrastructure, physical surroundings of the health care entity.

The second mainstream is patient experience management by other health care stakeholders. This management consists in influencing the experience built by the patient. It is often of indirect and long-term character. In certain cases, it can be oriented directly at a specific patient in the form of a personalized approach to treatment processes. However, this largely concerns activities with the character of building the image by treatment entities, including those performed by doctors during their medical practice.

Activities of public character, including health care (financed not only from public resources), are rarely a leader in the development and utilization of modern technologies. This does not concern specialized medical technologies (development of new medicines, new diagnostic methods, modern diagnostic and therapeutic devices etc.). Therefore, health service managers often utilize experiences of other commercial sectors. Undoubtedly, the companies from the financial sector, commerce and retail services are very experienced in management of customer relations.

Big medical entities and commercial insurers, especially in the market with high contribution of private service-providers, treat patients as a specific type of patient. Patient more and more often are exposed and follow general tendencies and phenomena connected with the development of consumer society, including commoditization³ of medical services (Lupton, 2013).

Analysis and measurement are critical in patient experience management. At the first stage, this means the evaluation of the current state as a source of decision data for evaluation of future activities. This can be achieved by conventional questionnaire surveys and sentiment analyses. Social media platforms can be the source of Big Data. Determination of the directions of activities that impact on patient experience should meet the detailed criteria defined in the entity's strategy. These may include e.g. dimensions (modules) of the model by B. Schmitt. The managers in the entity should define which dimensions of patient experience can have an effect in consideration for the specific entity, its size, type of services provided, access to adequate data and capabilities of processing them, and the expected efficiency of these activities.

However, the initiating party in creation of patient experience is mostly the customer, but the health care entity should be adequately prepared for the achievement of the initiated processes. This concerns adequate motivation and mobilization of the entire health care entity.

³ Commoditization consists in losing a uniqueness by a product or service and is the negative phenomenon for the corporate image and its competitiveness.

The focus on quality of the relation model (Rogoziński, 2008) is critical. The model should take into account the entities, experience participants, object of services and the relations between each other based on the contact platform.

5. The selected examples of the use of Big Data resources in patient experience management

PatientsLikeMe® (www.patientslikeme.com) is a social network of patients, with their aim being the improvement of the quality of life and health of the members. It also represents the research platform with a fast access to a broad scope of medical, sociological and other Big Data and results of the already conducted research. With this network, patients with similar health status and similar diseases can contact each other, present the methods of diagnosis and treatment methods, thus sharing their experiences. Consequently, the data concerning concrete diseases generated by a big group of portal users can be helpful and useful for researchers, health care entities, pharmaceutical entities, insurers and payers and other organizations connected with health care. At present, portal has over 600,000 members. It represents a trustworthy source of actual data on specific diseases with high clinical importance. The data from the portal have been used in over 100 of the reviewed scientific papers. Combined with the results of clinical studies and other medical data, including information on medicines, the open access to these research studies allows not only for extending the knowledge of patients and service-providers but it improves communication between patients and doctors and strengthens patient's engagement in treatment processes at each stage.

The portal's potential was appreciated by a large global medical-pharmaceutical corporation Walgreens Boot Alliance. Walgreens uses the most important information about side effects provided by the users of the portal with respect to over 5,000 medicines through inclusion of these data into all internet portals of the company concerning health. The data of PatientsLikeMe users turned out to be useful for the enterprise although the company has access to Big Data resources connected with a broad scope of their own activities and substantial internal research potential. The users of the PatientsLikeMe portal collect data on their moods, views and sensations related to the medicines used, which are likely to be insignificantly examined during conventional clinical and scientific studies.

Retail Pharmacy USA Division of Walgreens Boot Alliance (www.walgreens.com) is one of the biggest global suppliers of pharmaceuticals and products and services connected with general health protection. It manages over 400 clinics and over 8,000 pharmacies all over the world. Over 8 million customers uses the Walgreens' portals: Walgreens.com, Drugstore.com, Beauty.com, SkinStore.com and VisionDirect.com. (PatientsLikeMe, 2017).

An important component of management is control and measurement of the effects of concrete activities connected with building positive experiences. In practice, medical entities use questionnaire surveys to evaluate and measure patient experience. There are experiences and unified tools recommended by international organizations such as OECD and WHO (Garratt, Sullivan, Danielsen, 2008), whose aim is to measure patient experience at the level of national market. The set of tools named Consumer Assessments of Healthcare Providers and Systems (CAHPS®) has been used in the USA. CAHPS was designed by the Agency for Healthcare Research and Quality (AHRQ) in the USA in order to examine and measure patient experiences and create comparable standard reports (Hurtado, Angeles, Blahut, et al., 2005).

The Nordic Patient Experiences Questionnaire (NORPEQ) (Skudal, Garratt, Eriksson, et al. 2012) has been used in Europe. The use of data mining and artificial intelligence for Big Data analysis can represent a useful supplementation of conventional opinion polls while reducing their limitations, e.g. problems with research sample size, the lack of adequate representativeness and statistic character of the results. Conventional opinion polls are often too confirmatory. Research tools are developed based on previous similar examinations and the respective theories. The methods that utilize machine learning (especially without participation of the learning set) do not have such limitations and can have a clearly exploratory character (Al-Jarrah, Yoo, Muhaidat, et al., 2015).

Heritage Provider Network, Inc. (HPN) provides services connected with the broadly understood health care in the Southern and Central California. The company offers prevention services of health care, which include programs of health care for employees, vaccination and fitness programs. It manages health care by means of private medical groups. Educational sessions are provided for service-providers, clinicians, pharmacists and nurses about clinical guidelines, management of the use and chronic diseases (www.heritageprovidernetwork.com). HPN announced the contests (total of awards over 3 million dollars) for the development of e.g. the algorithm, which, based on Big Data, would identify a group of patients with large likelihood of hospital treatment over the nearest year. In July 2013, the award with 0.5 million dollars was won by a team of scientists and researchers in the field of data science POWERDOT (www.heritageprovidernetwork.com). This allowed for adequate planning of providing expected medical services. The interest attracted and proposal of early prevention medical services with respect to this group of patients had a positive impact on the image of this health care entity.

A number of portals have been functioning in Poland to facilitate patient experience management. Some of them are of recommendation character i.e. they are used to collect patients' opinions about doctors and health care units, mostly in the form of rankings. In addition to communication between users in the form of message boards, these portals offer counselling of professionals from various domains of health care, often by doctors with consideration for legal and ethical limitations concerning remote medical advice.

Most of the portals publish various popular science materials concerning health care. Examples portals (the numbers in brackets denote Alexa.com global rank as of 2018) include rankinglekarzy.pl (280k), dobrylekarz.pl (935k), znanylekarz.pl (21k). There are portals with broad range of health interests, such as mamzdrowie.pl (600k). The portals devoted to professionals, e.g. Medycyna Praktyczna www.mp.pl (17k) often offer the so-called patient's zone with information for users without medical background. The discussed portals are of local character in that they concern information about these doctors and health care entities that can be accessed by potential patients. Active participation of users of these portals represents an element of building their own patient experience while simultaneously creating Big Data resources which can be used for sentiment analysis.

The managers in global social network services provide access to non-personal data with access-providing software. For example, twitter.com made API⁴ accessible for active listening of the news stream and reading historical information matching specific query patterns⁵.

WizerunekLekarza.pl deals with monitoring and analysis of the opinions about health care entities. Among other tools, the company uses sentiment analysis. The company customers include health care entities and doctors who are interested in their image and monitoring. The scope of services includes:

- unlimited access to opinions about the doctor,
- free access to monitoring results,
- recommendations for activities,
- helping in the development of the doctor's image in the Internet.
(WizerunekLekarza.pl, 2018)

The type and scope of services proposed by the above listed portal can meet the role of a feedback used by service-providers for the assessment of their image and, indirectly, for evaluation of the quality of patient experience management.

6. Conclusions

Big Data resources represent a useful source of data used in decision-making processes concerning patient experience management. This mostly concerns the examination of the current status and the directions of activities that should be taken into consideration in further activity connected with patient experience management.

⁴ Application program interface is a set of routines, protocols, and tools for building software applications.

⁵ Access to such data is possible using, among other things, the "twitterR" package available in the R language environment. The package offers freeware access to all people who have an adequate level of programming skills. There are also more user-friendly tools that utilize Twitter data e.g. „WeFeel” – <http://wefeel.csiro.au>.

Big Data resources are utilized mainly in predictive analytic techniques performed by means of e.g. machine learning methods in providing personalized solutions for medical care. Big Data sources and analytical tools provided by the companies in the field of data science are known in this case. However, the effects of these analyses and the methods of their achievement are often the company's secret as they represent the potential competitive advantage. This concerns in particular pharmaceutical companies and less health care entities.

Exploring the relationships between core activities and factors that create positive patient experience may be difficult and uneconomic due to the complexity of the phenomena, type and structure of the data available for examinations, or impossible due to the lack of theoretical basis concerning the examined phenomena. Combination of analytical data mining tools, capabilities of artificial intelligence and potential of medical Big Data resources allows for discovering and using additional knowledge which can be difficult to be acquired using more conventional methods.

Popularization of information technologies, network communication platforms and development of virtual communities allows patients to build their own experiences more effectively. Patients have better access to reliable information from Big Data resources connected with professional medicine. Active participation of patients in medical and health virtual network communities generates large amount of data which can be used by other health care stakeholders and in patient experience management.

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