

Big data analysis for decision-making processes: challenges and opportunities for the management of health-care organizations

Big data
analysis for
decision-making
processes

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Abstract

Purpose – This study aims to provide a picture of the current state of art in the use of big data for decision-making processes for the management of health-care organizations.

Design/methodology/approach – A systematic literature review was carried out. The research uses two analyses: descriptive analysis, describing the evolution of citations; keywords; and the ten most influential papers, and bibliometric analysis, for content evaluation, for which a cluster analysis was performed.

Findings – A total of 48 articles were selected for bibliographic coupling out of an initial sample of more than 5,000 papers. Of the 48 articles, 29 are linked on the basis of their bibliography. Clustering the 29 articles on the basis of actual content, four research areas emerged: quality of care, quality of service, crisis management and data management.

Originality/value – Health-care organizations believe strongly that big data can become the most effective tool for correctly influencing the decision-making processes. Thus, more and more organizations continue to invest in big data analytics, and the literature on this topic has expanded rapidly. This study seeks to provide a comprehensive picture of the different streams of literature existing, together with gaps in research and future perspectives. The literature is mature enough for an analysis to be made and provide managers with useful insights on opportunities, criticisms and perspectives on the use of big data for health-care organizations. However, to date, there is no comprehensive literature review on the big data analysis in health care. Furthermore, as big data is a “sexy catchphrase,” more clarity on its usage may be needed. It represents an important tool to be investigated and its great potential is often yet to be discovered. This study thus sheds light on emerging issues and suggests further research that may be needed.

Keywords Big data, Health management, Health-care organization, Systematic literature review, Decision-making process, Cluster analysis, General management

Paper type Research paper



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1. Introduction

Information has always been considered the key input for improving organizations in all sectors, and in recent years, big data has been widely used by the information technology (IT) industry to produce critical information that produces considerable revenue.

Nowadays, there is plenty of data that floods organizational contexts, social activities, health care, etc. In this “data flood” era, technological advances support at any level what is not manageable with currently available technologies (Amorim *et al.*, 2017; Wang and Hajli, 2017). This phenomenon has led to the conception of the “big data” notion to give details about “the information asset characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value” (De Mauro *et al.*, 2016, p. 128).

Organizations seeking to mitigate risk by making their businesses more smart and reactive are using big data to change the approach to how problems are observed and to support managers in taking strategic actions. From the general literature on the role of big data in organizational decision-making process, it is observed that the organizations considering the capabilities of big data are able to make more informed decisions useful in helping them gain a competitive advantage, improve overall performance and boost their bottom line (Janssen *et al.*, 2017; Cristofaro, 2017; Talaoui and Kohtamäki, 2020). Also, based on events arising from past experiences, big data can be used to automate processes, gain knowledge for the target audiences and improve performance using an in-depth market understanding. The business’s power to use the information collected during daily actions is big data (Vidal-García *et al.*, 2019).

Big data has been also considered strategic for marketing studies as technology helps capture rich and plentiful data on consumer phenomena in real time (Erevelles *et al.*, 2016; Arunachalam *et al.*, 2018). This type of data connected to customer analytics has a direct impact on resource management in relation to how this data is collected and stored, extracted and standardized, and how this information is used to enhance dynamic/adaptive capabilities (Erevelles *et al.*, 2016). By discovering opportunities, identifying risks and consolidating decision-making frameworks, the big data plays an important role in maximizing the organizational effectiveness (Zhao *et al.*, 2021). Furthermore, big data supports managers to make decisions according to statistical details. The latter are used to guide decisions on future organizational growth by evaluating managerial aspects in the long term (Grover *et al.*, 2018).

The literature on the role of big data in organizational decision-making process focuses on improving the understanding of diverse actions and procedures for transferring information (Fombellida *et al.*, 2020). For organizations using big data analytics in decision-making process, reducing the error and data range is an important goal. Previous research in big data, a part from health-care and crisis management, has applied mainly in the field of blockchain and logistics (Govindan *et al.*, 2018; Wamba and Queiroz, 2020). In both cases, previous research has highlighted the need to develop better technology-driven tracking strategies, financial performance relations with data-driven supply chains and implementation issues (Wamba and Queiroz, 2020).

However, the extensive use of big data and data acquisition from organization is not without threats. In particular, the use of potential private and sensible information from users and costumers open the door to the discussion on the ethics on the use of this type of information for managerial and strategic purposes while exploiting the potential of important information sharing for development and innovation (Cuzzocrea *et al.*, 2022).

Describing the impact of this data on the global health system revolution and on the decision-making process of health-care managers is thus an important challenge for

academia and the scientific community. This is particularly true as the health-care organizations show different elements of uniqueness. In fact, health-care organizations differ significantly from other types of organizations when using big data for decision-making process:

- In this type of organization, the professionals' action is a priority (professionals are characterized by significant autonomy), and therefore, the decision-making processes for the use of resources are strongly conditioned by individual choices and wishes of professionals (Légaré *et al.*, 2018).
- Where the health sector is public (as several countries in the world) or in any case it is strongly controlled by the public regulatory system, the decision-making and administrative processes are strongly conditioned by these external aspects, unlike other types of organizations (Vainieri *et al.*, 2020).
- Finally, decision-making processes generating concrete outputs are not always able to evaluate the process that generated the outcome of health-care organizations. Therefore, it is international practice to evaluate health-care organizations in a multidimensional way: searching for the correlation between resources used and outcomes is highly crucial (Sousa *et al.*, 2019).

As this research is focused on the use of big data in the decision-making processes of health-care management, the abovementioned three aspects significantly affect the identification of management models, the distribution of responsibilities among professionals (therefore the evaluation of the partial results of each area responsibility) and also the processes of allocating resources within the health-care organization.

Health care is one of the social needs that has a clear requirement for big data analysis (Wang and Hajli, 2017). Health-care organizations are today generating data at an incredible speed, and this is bringing advantages and disadvantages at the same time. The process of information exchange generates a challenge in which, on the one hand, there is poor health-care information management and, on the other hand, inadequate integration of health-care systems (Chinnaswamy *et al.*, 2019). The huge flow of digital information generated increasingly rapidly in the health-care industry adds complexity to the relationship, in a situation where disequilibrium can lead to avoidable increases in medical costs for both patients and health-care providers. Health-care organizations are thus looking for efficient IT tools that allow them to better manage executive resources to distribute high-quality patient care, improve health-care performance and create more useful business models based on data-evidence (Agarwal *et al.*, 2010; Goh *et al.*, 2011; Ker *et al.*, 2014).

The literature demonstrates that the growing complexity of analytical decision-making requirements can make the human mind unable to take correct business decisions, so that analytics are becoming an essential tool for businesses. With the use of IT, analytics can, in fact, create simulation systems that can improve the performance and management of health-care organizations and, at the same time, predict business outcomes and stakeholder behavior.

Health-care organizations strongly believe that big data can become a very effective tool to correctly influence the decision-making processes (Chinnaswamy *et al.*, 2019). This thinking is confirmed by the fact that most organizations continue to invest in big data analytics.

Consequently, research in the last decade has focused on big data in the health-care sector and the literature has expanded rapidly (Dash *et al.*, 2019). The literature is in fact mature enough for an analysis to be made to provide health-care managers with useful

insights on opportunities, criticisms and perspectives on the use of big data for health-care organizations. In sum, this research aims to provide a clear picture of the current state of art, by performing a systematic literature review on the published works and clustering them into different research areas (RAs), each area representing a major topic currently addressed by the literature.

The study seeks to answer the question: *What has been done so far by scholars and what issues still need to be investigated?* and is structured as follows. After the introduction, Section 2 describes the search method and the steps performed in literature review. Section 3 presents findings in two different categories: the first describes the results and the second addresses the main issues emerging from the literature. Section 4 discusses the findings, and Section 5 presents the conclusions of the study and recommendations for future investigation.

2. Method

This paper presents a systematic literature review (SLR) of 48 papers identified in relevant journals out of the more than 5,000 articles retrieved from the database Scopus.

To identify the data set, researchers examined several published literature databases, namely, Web of Science, PubMed and Scopus. Scopus was found to provide the broadest coverage and is thus used as the basis for this SLR. It includes more than 20,000 peer-reviewed scientific journals (Mishra *et al.*, 2017).

It was decided to conduct an SLR for two reasons. First, an SRL implies a detailed description of research steps and builds on a deeper methodological approach, which thus reduce biases and provide increased transparency for the reader (Saenz *et al.*, 2015). This makes the research replicable, as well as giving it greater methodological value (Fisch and Block, 2018). Second, although this review looks at a relatively recent topic, an SLR makes it possible to integrate a number of different works on the same topic, “summarizing the common elements as well as contrasting the differences while extending the work in some fashion” (Saenz *et al.*, 2015 – p. 21). In the light of its exponential growth in terms of research over the past five years (Favaretto *et al.*, 2020), the issue of big data in health care appears to be ripe for a literature review.

2.1 Sampling

For inclusion in the sample, papers were subject to several criteria that define them as relevant to the scope of the analysis. A preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram was used to identify the sample. PRISMA (Figure 1) makes it possible to identify the final set of articles to work on following a four-step approach:

- (1) identification of works;
- (2) screening of suitable articles;
- (3) checking eligibility of publications; and
- (4) inclusion of the articles that will be subject to the analysis.

Boolean research on Scopus was carried out retrieving the following keywords: “Big Data” OR Big-Data OR BigData AND “Hospital” OR Health*.

The download, completed in December 2020 to include all papers published up to the end of the year, produced a full data set of 5,715 papers.

The gray literature, in other words, conference proceedings, book chapters and all the literature that did not take the form of an academic paper, was excluded. The final step of the PRISMA model, consisting of the eligibility check and assessment of papers, which

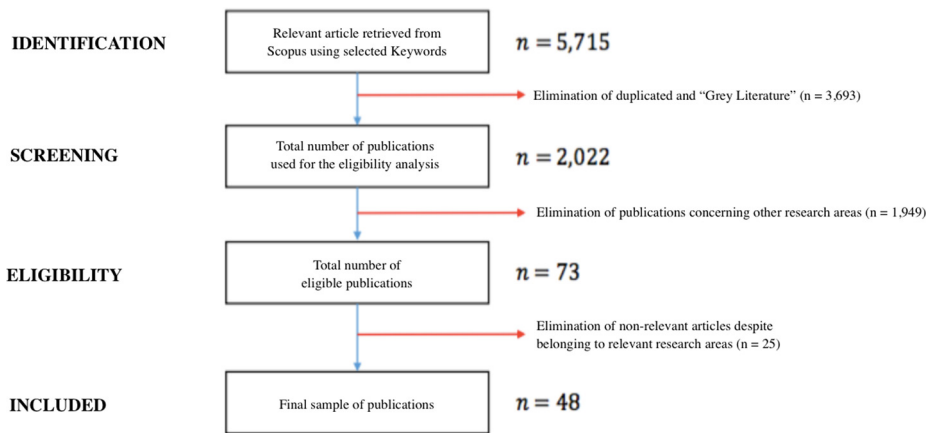


Figure 1.
PRISMA flow
diagram

finalized the sample for the bibliometric analysis, was conducted by different researchers. The rate of agreement among researchers was calculated by identifying the Cohen's κ coefficient, which measures the inter-rater reliability of choice (Fanelli *et al.*, 2020). The Cohen's κ of 0.8491 was acceptable. As shown in Figure 1, the final data set includes 48 peer-reviewed papers, ranging from the year 2013 to the year 2020.

2.2 Research design

The SLR uses two different types of analyses: a description and a bibliometric analysis of content. For both analyses, Excel and VosViewer® were used.

In the descriptive part, the results section reports the evolution over time of the number of published articles and their impact measured by the adjusted number of citations. To assess and prevent the impact of time on citations, Massaro *et al.* (2015) suggest the use of the Citation Per Year (CPY) index. This index makes it possible to take into account the lag time for citations, which biases older articles compared with more recent publications (Fanelli *et al.*, 2020). The calculation of the index is expressed by equation (1):

$$CPY = \frac{c}{(x - y)} \quad (1)$$

where c stands for the number of obtained citations for each paper, x indicates the year 2021 and y is the year of publication of the article.

The bibliometric analysis for content evaluation follows the procedure described by Christoffersen (2013) for examining research issues to deliver insights and criticisms. The present SLR uses the visualization of similarities technique, developed by Van Eck and Waltman (2014) and recently retrieved by Fanelli *et al.* (2020). The software used to conduct this part is VOSViewer®, which is based on the concept of distances between two objects and visualizes these distances in different ways.

Finally, bibliographic coupling is performed. This is a measure of similarity that analyses the citation of third publications to establish a similarity relationship between documents, and assigns a score according to how much of the bibliography is in common between the papers. The more overlap between the literature, the stronger the link between papers. This identified a subsample of articles with significant links between them,

and also revealed the different RAs, corresponding to the key issues addressed by the literature on big data uses in health management.

3. Results

As noted in the methodological section, the results appear in two sections: descriptive results and bibliometrical results. The descriptive results section covers:

- evolution of citations;
- evolution of keywords; and
- the ten most influential papers.

The bibliometric part includes a cluster analysis and a careful reading of works to make a clusterization based on the actual content of papers.

3.1 Descriptive results

3.1.1 Evolution of citations. The trend of the evolution of citations is shown in [Figure 2](#). No articles on big data use by health-care management were published before the year 2013. The number rose rapidly from 2018, suggesting that the topic is current and that literature is increasingly focusing on the issue. As big data use for health care has only recently become a topic of investigation by scholars, many aspects remain to be examined in depth.

The citation ratio shows a slight dip in 2020, but this reflects the fact that articles published in 2020 have not as yet had time to gain visibility. The trend of overall CPY per year is rising and is affected by the presence of certain outliers. CPY analysis indicates which year produced proportionally the most visualized papers. Overall, CPY for the year 2013 is 0.81, while for 2019, it is 2.11. The year 2017 is affected by the presence of an outlier, which brings the overall CPY to 9.63. [Wang et al. \(2017\)](#) obtained 106 citations (26.50 CPY), while the average citation ratio is 3.24.

3.1.2 Keywords analysis. The analysis of keywords makes it possible to overcome the issue of selection bias, which is very frequent in literature reviews ([Zhang et al., 2016](#)). It can be particularly useful in an analysis based on a shorter time frame.

Trend of all articles vs. cited articles

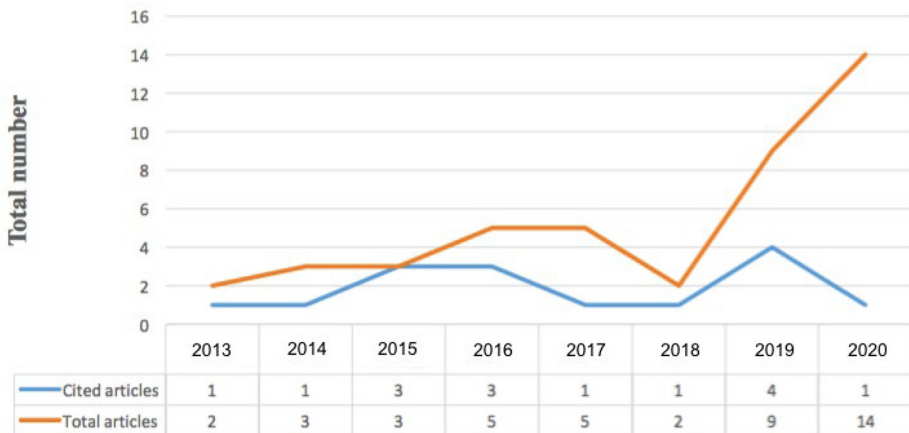


Figure 2.
Trend of articles
(cited articles vs
number of
publications)

Figure 3 represents keyword occurrence and their evolution over time. The bigger the dot, the more frequent the keywords. The most frequent keywords are shown in yellow; *Covid-19*, *Contact Tracing* and *Epidemics* are clearly overrepresented, as the recent COVID-19 pandemic impacted on every RA. The terms shaded in light green are perhaps a more precise indicator of where the literature is heading, and suggest that the major issues for research in 2019 were the relationship between big data and *Intellectual property* as well as the use of big data in *Public Health*. The issues most frequently discussed at the beginning of the literature strand were the relationships between *Communication Technology*, *Change Resistance* and *Digital data*.

Although the use of big data in healthcare management is undergoing exponential growth, it is still a new field in which many aspects require scholarly investigation.

3.1.3 *The most influential papers.* As a follow-up to the analysis described so far, CPY is next used to identify the ten most influential articles (Table 1).

3.2 Bibliometric results

3.2.1 *Cluster analysis.* Forty-eight articles were selected for bibliographic coupling. Of these, only 29 are linked on the basis of bibliography (Table 2). The closest link scores 35, which indicates that the bibliography of Erickson and Rothberg (2017) shares 35 citations with the complete list of selected papers. The mean link score among the selected papers is 6.79, and the median is 4.00. Figure 4 shows the results of Visualization of Similarities (VosViewer®) and outlines the interrelationships between the bibliographic references of the papers. Table 2 provides further details and places each article into a different cluster. The software identifies five different areas, each represented by a different color. This classification is

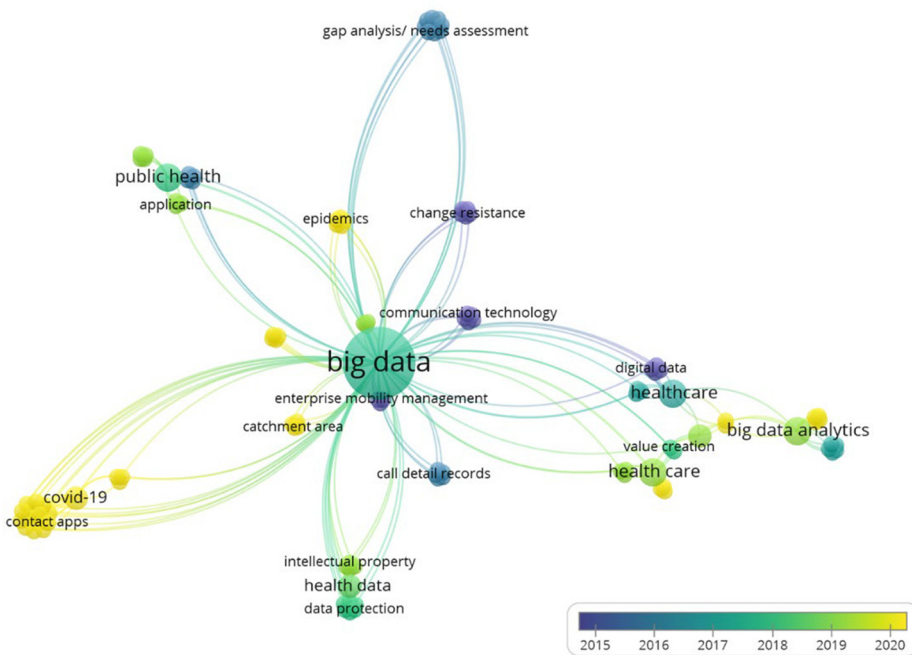


Figure 3. Keyword bibliographical map

Table 1.
Ten most cited
articles (weighted by
CPY)

Author(s)	Title	Year	Source title	Cited by	Cpy
Wang Y., Hajli N.	Exploring the path to big data analytics success in healthcare	2017	<i>Journal of Business Research</i>	104	26.00
Ellaway R.H., Pusic M.V., Galbraith R.M., Cameron T.	Developing the role of big data and analytics in health professional education	2014	<i>Medical Teacher</i>	76	10.86
Wang Y., Kung L., Gupta S., Ozdemir S.	Leveraging Big Data Analytics to Improve Quality of Care in Healthcare Organizations: A Configurational Perspective	2019	<i>British Journal of Management</i>	17	8.50
Heath-Kelly C.	Algorithmic autoimmunity in the NHS: Radicalisation and the clinic	2017	<i>Security Dialogue</i>	32	8.00
Fiore-Gartland B., Neff G.	Communication, mediation, and the expectations of data: Data valences across health and wellness communities	2015	<i>International Journal of Communication</i>	46	7.67
Fiske A., Buyx A., Prainsack B.	Health Information Counselors: A New Profession for the Age of Big Data	2019	<i>Academic Medicine</i>	13	6.50
Cinnamon J., Jones S. K., Adger W.N.	Evidence and future potential of mobile phone data for disease disaster management	2016	<i>Geoforum</i>	27	5.40
Xia T., Song X., Zhang H., Song X., Kanasugi H., Shibasaki R.	Measuring spatio-temporal accessibility to emergency medical services through big GPS data	2019	<i>Health and Place</i>	10	5.00
Fu C., Liu W., Chang W.	Data-driven multiple criteria decision making for diagnosis of thyroid cancer	2020	<i>Annals of Operations Research</i>	5	5.00
Kim M.-K., Park J.-H.	Identifying and prioritizing critical factors for promoting the implementation and usage of big data in healthcare	2017	<i>Information Development</i>	18	

Author(s)	Year	Citations	CPY	Link-score	Cluster
Erickson and Rothberg	2017	11	2.75	35	Blue
Gravili <i>et al.</i>	2020	0	–	28	
Wang <i>et al.</i>	2020	3	3.00	11	
Goffey <i>et al.</i>	2014	4	0.57	7	
Petković and Lukić	2013	0	–	5	
Chinnaswamy <i>et al.</i>	2019	4	2.00	3	
Harz	2017	0	–	1	
Marelli <i>et al.</i>	2020	4	4.00	24	Green
French	2014	19	2.71	21	
Andanda	2019	1	0.50	14	
Heath-Kelly	2017	30	7.50	9	
Fiore-Gartland and Neff	2015	46	7.67	6	
de Magalhães <i>et al.</i>	2016	1	0.20	4	
Kim and Park	2017	18	4.50	4	
Roberts	2019	1	0.50	1	
Milusheva	2020	0	–	2	
Dhagarra <i>et al.</i>	2019	4	2.00	7	Purple
Klingwort and Schnell	2020	0	–	2	
Cinnamon <i>et al.</i>	2016	27	5.40	21	Red
Du <i>et al.</i>	2020	0	–	10	
Rains	2020	1	1.00	8	
Xia <i>et al.</i>	2019	10	5.00	5	
Ellaway <i>et al.</i>	2014	76	10.86	5	
Huang <i>et al.</i>	2020	0	–	4	
Wang and Hajli	2017	106	26.50	22	Yellow
Ratia <i>et al.</i>	2018	2	0.67	23	
Fiske <i>et al.</i>	2019	13	6.50	6	
Swain	2016	9	1.80	2	
Holtrop <i>et al.</i>	2019	3	1.50	2	

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Table 2. Link scores for each paper and cluster identified by VosViewer®

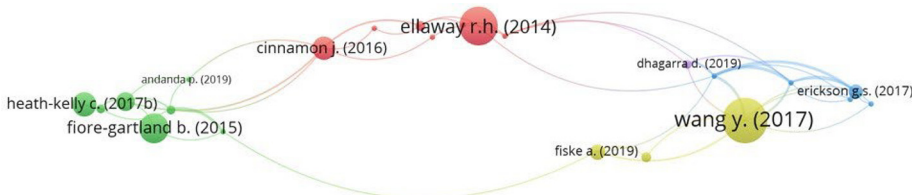


Figure 4. Paper clustered by Visualization of Similarities technique

based only on the bibliographic coupling used with the Visualization of Similarities technique and does not take into consideration the topic of the papers.

3.2.2 Identification of research areas. Papers were selected through the bibliometric clustering process and carefully read by researchers to classify RAs. Only papers with a Link-score of at least 4, the median of the entire data set of relevant publications, were considered, in other words, 22 articles of the total 48 (45.83%). The process identified four RAs, representing the four main issues addressed by the current literature.

3.2.3 RAI – quality of care. The first RA includes five articles (Fiore-Gartland and Neff, 2015; de Magalhães *et al.*, 2016; Dhagarra *et al.*, 2019; Gravili *et al.*, 2020; Rains, 2020). These articles show how big data is seen as a useful tool for health-care organizations in improving care performance. Many studies in this RA highlight the importance of using big data to

support both professionals and hospitals for health outcome improvement. In fact, the use of large amounts of data not only facilitates the use of predictive models but can also transform the way and the timing with which clinical activities are carried out, producing benefits for the health of patients (Dhagarra *et al.*, 2019). Crisan *et al.* (2020) argue that big data is useful for more effectively defining individualized treatments and care pathways for users, producing a greater impact on patients' behavioral styles and reducing inefficiencies. In addition, the Healthcare Information and Management System Society (Acumen Physician Solutions, 2017) states that the collection, analysis and application of big data can help prevent the spread of diseases, provide more effective care treatments and make knowledge transfer more effective between health professionals.

The main effect of hospital management using big data, as found by de Magalhães *et al.* (2016), consists of the "technological opportunities and trends for global public health," as it increases the capacity to transmit accumulated knowledge between different professionals. This is confirmed by the best practices applied in many hospitals. The theory is also confirmed by Rains (2020), who finds that big data can be used to understand public perceptions of health issues and, consequently, define the best health responses. Knowing how the community perceives a health communication campaign makes it possible to design prevention programs that are increasingly effective and individualized for the different categories of patient. Finally, Gravili *et al.* (2020) state that using adequate tools makes it possible to make forecasts and guide diagnostic and therapeutic decisions. Gravili *et al.* (2020) also find that the advantage of big data is that it allows access to both explicit and implicit knowledge. Effective management of this knowledge makes it possible to increase the quality of care.

3.2.4 RA2 – quality of service. The use of big data by health-care organizations is closely related to performance improvement of an organization, creating value and guaranteeing a higher quality of service as well as the possibility of improving the quality of care provided (Wang *et al.*, 2020). The second RA focuses on quality of service and includes six articles (Erickson and Rothberg, 2017; Wang and Hajli, 2017; Ratia *et al.*, 2018; Xia *et al.*, 2019; Du *et al.*, 2020; Wang *et al.*, 2020). A complete implementation of big data analysis can also generate a reduction in costs, better business planning, a better patient experience and, therefore, greater satisfaction (Erickson and Rothberg, 2017). Two main themes emerge in this RA. The first is the use of big data to generate greater value for the health-care organization and for the patient (Wang and Hajli, 2017; Erickson and Rothberg, 2017; Ratia *et al.*, 2018). The second is accessibility of health services (Xia *et al.*, 2019; Du *et al.*, 2020; Wang *et al.*, 2020).

Wang and Hajli (2017), using 63 hospitals as case studies, investigate the causal relationship between the use of big data and the organization's sources of value creation. The main aspects of big data analysis which increase healthcare service quality are identified and grouped into five main areas: traceability, analysis, speed of decision-making, forecasting and interoperability. In RA2, Ratia *et al.* (2018), find that the combination of big data, intellectual capital and business intelligence tools allows health-care organizations to make better decisions at the organizational as well as clinical level, which creates value for patients and improves service quality. Erickson and Rothberg (2017) highlight how big data can be useful for better identifying patient problems, adopting consistent treatment processes, managing different cases, improving relationships with patients and offering an overall improved quality service.

Regarding accessibility of health-care services, Du *et al.* (2020) suggest concentrating resources in peripheral hospitals to ensure equitable access to health services. Public transport plays an important role in ensuring equal opportunities for access to services

especially by people with low socioeconomic status. A similar study was conducted by Wang *et al.* (2020). In this case, accessibility of hospitals was investigated by analyzing taxi routes. The study reveals that citizens prefer health-care organizations located in the city center and their choices are influenced by characteristics of the hospital such as its size, reputation and specializations, and by the individual's medical insurance. Finally, the model developed by Xia *et al.* (2019) can be used to produce better health planning, offering more accessible health services to citizens. The advantage of this study, compared with the others, is that in evaluating the accessibility of emergency health organizations, it includes the variable of time as well as space.

3.2.5 RA3 – crisis management. The third RA include four scientific publications (French, 2014; Cinnamon *et al.*, 2016; Heath-Kelly, 2017; Huang *et al.*, 2020) focusing on crisis management literature. This is not a new issue for health management scholars, as historical events have shown that crisis cannot be considered to be impossible. Rare though they may be, however, crises can have dramatic consequences, which take a very long time to deal with (Pratici *et al.*, 2021). Recent events, in fact, show that it can be dangerous to be without a resilient model to react to crisis (Huang *et al.*, 2020), and there is already some research on this issue investigating a possible relationship between the use of big data and the definition of resilient model for crisis management.

Crisis management can be considered at three different moments: before, during and after the crisis.

The literature finds that before the crisis, it is important to assess the risk linked to specific events (Alexander, 2002) and that big data can be used in designing predictive models and identifying potential tools (French, 2014; Heath-Kelly, 2017). During the crisis, it is important to develop an efficient communication strategy, and big data can enable an organization to transmit information in the shortest time possible (Heath-Kelly, 2017). After the crisis, big data can be used to rebuild and restore, and can help to codify learnings and design resilient models to enable the organization to react more effectively in the event of new crises (Cinnamon *et al.*, 2016).

In particular, Cinnamon *et al.* (2016) examine the role of active and passive data generated by mobile phones. This data could be particularly useful for the management of health emergencies related to epidemics as it can accurately track people's movements and possibly minimize very quickly contacts between infected and noninfected citizens. On the same wavelength, French (2014) argues that the use of big data and new technologies should allow the activation of a public health surveillance system, so as to prevent the spread of disease. The study by Heath-Kelly (2017), on the other hand, investigates how big data can be used to train health-care professionals to recognize signs of "radicalization" in their patients or colleagues as a counter-terrorism measure. The most recent study by Huang *et al.* (2020), defining an information analysis framework about the COVID-19 pandemic, uses five dimensions: epidemic, medical, governmental, public and promotional. Analyzing crisis events through big data makes it possible to monitor feelings and judgments that people express online, so as to be able to act promptly to check the spread of the virus. These studies show how information about COVID-19 has significantly changed over time in all five dimensions.

3.2.6 RA4 – data management. The fourth RA includes seven articles that address the main challenges health-care organizations face when managing big data (Petković and Lukić, 2013; Ellaway *et al.*, 2014; Goffey *et al.*, 2014; Kim and Park, 2017; Andanda, 2019; Fiske *et al.*, 2019; Marelli *et al.*, 2020). According to the Deloitte Center for Health Solutions (2015), 60% of health-care organizations have not yet been able to effectively implement

tools for analyzing big data. This is because the implementation requires a transformation of organizational processes, which are very often resistant to change (Marelli *et al.*, 2020).

In general, health-care organizations face many issues in big data management.

From a legal point of view, the study carried out by Andanda (2019) presents three main issues related to the use of big data by health-care organizations:

- (1) data access;
- (2) informed consent; and
- (3) data ownership.

Andanda (2019), in fact, suggests talking about data “custody,” rather than data “ownership.” Marelli *et al.* (2020) ask whether the provisions of the 2018 General Data Protection Regulation (GDPR) are applicable to the management of big data in health care and suggest that they may not be so. From an organizational point of view, Petković and Lukić’s (2013) note that the introduction of big data affects decision-making and coordination processes, possibly necessitating important changes in the organizational structure. The study by Goffey *et al.* (2014) argues, on the other hand, that a crucial aspect for the big data implementation by health-care organizations is the availability of adequate technologies. This requires a reorganization of the technological infrastructures and a digitalization of all processes, increasing their interoperability. From an educational point of view, Ellaway *et al.* (2014) show how big data can be useful in the training processes of clinicians for four reasons: it provides more information on skills; it allows the training institution to evaluate performance; it makes it possible to compare performances between different institutions; and it makes it possible to combine data on theoretical training with those of clinical practice. Fiske *et al.* (2019) also suggest the development of a new professional profile, “data manager and health information advisor,” to provide skills necessary to process and interpret big data.

Finally, more in general, Kim and Park (2017) identify the main factors influencing the implementation and use of big data in health-care organizations. Overall, 15 factors determining the success of big data implementation are identified and grouped into four areas: data, technology, organization and support.

4. Discussion

The use of big data in the health-care context is a relatively recent development but is already showing great potential. The growing interest shown by researchers and health-care professionals is linked to its numerous advantages for health-care organizations. The findings of this SLR confirm that the use of big data in health care improves the service for users, makes the organization more flexible, increases quality, reduces costs, supports decision-making processes and improves the monitoring of activities. The increasing number of citations that papers on big data are receiving also confirm the growing interest in the topic.

The bibliometric analysis of the 22 scientific articles identifies four main RAs. Each RA highlights how big data can be used by a health-care organization to generate value for the organization itself and for the community. More precisely, the first three RAs concern the benefits that big data analysis can generate in terms of improving quality of care, quality of service and crisis management. The fourth area includes elements that health-care organizations need to develop to manage big data effectively.

Big data is a wide concept and it refers to different types of data: user-generated content data (from the users on social media in texts, photos, etc.), device-monitored data (by

meteorological monitors, smart meters, GPS, etc.) and activity log data (for web searching/visiting, online/offline marketing, clinical treatments, laboratory experiments, etc.) (Tang *et al.*, 2022). As health-care organizations already produce millions and millions of documents every day (Iveroth *et al.*, 2013), the main research interest of big data usage in health care from a management perspective mainly refers to activity log-data related to health-care records, and partly on device-monitored data. The use of block chain technology appears to be the only way to manage effectively this amount of data (Amorim *et al.*, 2017; Wang and Hajli, 2017). The future path of health-care organizations in fact is leading toward increasingly sophisticated tools for big data processing.

RA2 is complementary to RA1, as the concept of quality switches from care to the quality of the whole service (Andaleeb *et al.*, 2007). The general objective of RA2 is to provide useful tools to exploit the potential of using big data to offer more equitable and higher-quality health services to citizens. Here too, this means providing services of a higher quality. This entails improving access to health services, building better relationships with patients, developing new products and services closer to user needs, improving processes, increasing operational flexibility and reducing costs. The literature in fact notes that today, decision-making processes can and should be addressed using tools able to manage big data (Kościelniak and Puto, 2015). Articles in RA2 are generally more recent than articles in RA1. This confirms the hypothesis that the over the years, quality has shifted from being an issue relating to care to being an issue relevant to the whole organization (Øvretveit and Gustafson, 2002). This trend reflects the results illustrated in the general literature on the role of big data in organizational decision-making, which provide important information which results in competitive advantage and improvement of the overall performance (Janssen *et al.*, 2017; Cristofaro, 2017; Talaoui and Kohtamäki, 2020). Indeed the use of big data has a direct impact on the organizational procedures, which includes understanding of big data in supply chain and optimizing the data generation; importance of integrating and standardizing heterogeneous data types; and the use of several types of analytics to assimilate the findings into the business processes (Arunachalam *et al.*, 2018). In addition to that, health-care research of big data confirms the trend to use urban mobility to better design services for users, which ensure sustainable and social equity (Kong *et al.*, 2020).

The third area, RA3, contains articles relating to the contribution of big data analysis to crisis and emergency management. This is one of the main areas of research in the study of the potential use of big data for the improvement of crisis management literature (Kushwaha, 2021), mainly used to improve the ability to communicate with the population (Wang *et al.*, 2020) and face organizational crisis (Watson *et al.*, 2017). This issue is especially relevant for health care to the current ongoing COVID-19 pandemic and potential threads related to catastrophic events such as natural disaster or war. The experiences of many health organizations around the world show clearly that the vast majority were completely unprepared to face such a crisis (Mason and Friese, 2020). Big data could provide a contribution to all stages of crisis development, perhaps even preventing a crisis event, or at least reducing its impact. The current situation leads us to predict there will be a vast output of research on crisis management, which to date has not yet been thoroughly explored. Researches in healthcare big data management reflects the research in the field of the use of big data in crisis management literature, which highlight the importance of this type of data for the stage of preparedness and mitigation/response of the crisis. Reflecting the trend of other research in the field lower attention is still given to the phase of crisis and disaster recovery (Kushwaha, 2021).

Finally, the articles included in RA4 underline that the complexity of big data necessitates appropriate investments in improved technologies and skills by health-care organizations. The large number of articles shows that the issues can be approached from different perspectives: legal, technological, organizational and infrastructural. All these areas require in-depth study and separate analysis, as the ability to govern and manage big data is essential to fully exploit its potential. The major issue in RA4 appears to be legal aspects of the use of big data, and the main areas of debate in the literature are related to data access, informed consent, data ownership, data security, and privacy. The complexity and thread in the use, acquisition and storage is of particular interest for businesses in general. In particular, a more careful and thoughtful use in the storage of this type of data followed the introduction of the GDPR rules, raising concerns on how this type of information could be stored and shared (Georgiadis and Poels, 2022).

5. Conclusions

The organizational aspect and the resistance to change connected to the implementation of new big data-based models are topics that require urgent consideration, and there is little discussion in literature to date on this its qualitative dimension. As pointed out by Kushwaha *et al.* (2021), conventional management practices have been increasingly urged to improve the management model because of the arrival of big data, which has been used to make informed decisions. In the case of health-care sector, the introduction of management practices related to big data has been mainly applied to service and strategy, leaving potential other managerial practices (such as operation and human resources) as potentially new field to be explored. On the other hand, topics such as quality of care and its relation with big data use, and the performance measurement of health-care organizations have received more academic attention.

The legal underpinnings of big data use are partially addressed by authors such as Hashem *et al.* (2015), Almeida and Calistru (2013) and with regard to managerial implications by Andanda (2019). But the topic is far from exhausted and numerous issues are yet to be analyzed. The COVID-19 pandemic led to a slowdown of investigation in 2020, but keyword evolution over time showed that the legal aspects of data protection were clearly an emerging topic in 2019. There is no reason to believe that this trend will not continue after the pandemic.

A further finding of the SLR concerns the influence of the recent ongoing COVID-19 pandemic on big data usage (Huang *et al.*, 2020). During the pandemic, critical events improve the capacity of an organization to adapt and implement resilient strategy (Pratici *et al.*, 2021). Big data, as a new effective technological tool, was a widely explored topic and the crisis contributed to the growth of the academic research on this issue.

So there remain plenty of opportunities for researchers interested in these issues. Big data are proven to be a useful tool for generating progress, but they are not without disadvantage. In this regard, it can be argued that few hospitals and health organizations have skilled staff capable of engaging in big data analytics (Wang *et al.*, 2018). Those few organizations, while having skilled staff in the big data use for health purposes, are not prone to publish their results as these are often kept as internal differentiating information and, therefore, kept confidential (Lai *et al.*, 2017). All this skews the available scientific literature addressing it toward a different perspective from the actual value and use of big data compared with what health-care professionals actually see and use. Another aspect to consider is the lack or limited availability of data for those who perform this type of analysis for health organizations (Poston *et al.*, 2006). Indeed, some hospitals or clinics would like to use this skilled staff to determine the best way to care for patients, but are often hampered by privacy concerns, missing data and, sometimes, high costs for access to data. Some of the organizations that have significantly organized this activity are included in large health

systems or those associated with public health plans, such as: Cleveland Clinic (in Ohio), Mayo Clinic (in Minnesota) or Karolinska Institute (in Sweden). In these realities it is possible to see how they are using their wealth of advanced data and analytics to face health challenges, improve the management of healthcare organizations and, also, improve the overall health and well-being of their patients (Grüning *et al.*, 2019). Key leaders in management and analytics at these organizations are constantly using big data to improve analytics tools and to continue expanding their mission.

However, there are still many issues to investigate. Professionals will be increasingly involved in the use of big data, but they need to be technically and culturally trained for this. Rather than perceiving big data as a threat, ideally they should see it as an opportunity for improvement. Our analysis of the current literature, however, finds that this aspect is completely (or almost completely) unexplored. Future research can lay the groundwork for understanding how big data could be used, managed and shared with stakeholders to advance knowledge both for the ongoing decision-making process and during crisis to advance knowledge for the phase of disaster recovery and reconstruction (Kushwaha, 2021). Additional opportunities for the successful use of big data in health care includes models for sharing insights and open access database to stakeholder for creating value and advancing knowledge while ensuring privacy (Cuzzocrea *et al.*, 2022). Other possibilities will be to strengthen the possibilities of usage of other user-generated content data such as social media, already used in other context such as marketing studies for capturing rich and plentiful data on consumer phenomena in real time (Erevelles *et al.*, 2016; Arunachalam *et al.*, 2018). Research should also find a way to integrate multiple big data sources (Kong *et al.*, 2020) to provide more insights into user perception, which will help to design tailor-made services. The pending questions are principally related to the high incidence of scientific research-based literature rather than on real experiences lived by health professionals (as it has been seen in other health-care areas such as quality improvement). Further “issues still to be investigated” are related: (1) to what is the effectively recoverable amount of data, (2) how big data can be constantly recorded, (3) what is the “quality” assured to the data and, finally, (4) how much data is actually used to regulate the usual care provided to patients.

This study is not without limitations. From the methodological perspective, it is possible to identify at least two limitations. The first is that our data set does not include the gray literature. It was excluded as it is generally related to preliminary studies and, as such, concerns fields at the very beginning of their development (Fanelli *et al.*, 2020). Furthermore, a small number of false negatives are due and are to be expected in the selection process, either because of human errors or because of automatic exclusion in the Boolean research. This may weaken the analysis, but it is hoped that the SLR format limits possible biases arising from this issue.

Limitations, however, concerns also the definition of big data. The literature is full of various definitions of big data, based on different works, sometimes very different from one another (Al-Mekhlal and Khwaja, 2019; Ward and Barker, 2013; Hajjaji *et al.*, 2021). As big data is a “sexy catchphrase,” more clarity regarding what is meant by “big data” may be needed. This certainly is a big issue in the analysis proposed, which cannot take into consideration all the facets that big data may assume.

Despite the underlined limitations, big data still represents an important tool to be investigated, as its great potential is often yet to be discovered. This study aimed to discuss the use of big data in health-care organizations management and, as such, shading lights on the main issues emerging from its usage. In other words, what has been done in the past, to try to define what can be done in the future.

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Further reading

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