Correlation Analysis And Beyond: Overcoming Implementation Challenges In Big Data Analytics For Medical Institute Libraries In Pakistan

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Abstracts

Purpose – The primary aim of this study is to discern the challenges confronted by library professionals operating within medical institutions and their associated teaching hospitals in Pakistan during the implementation of Big Data Analytics (BDA). The study aims to conduct correlation analysis to establish the relationship between these challenges and various factors, including legal and ethical, technological challenges, knowledge and skills, as well as organizational challenges.

Design/methodology – A Quantitative Survey design was utilized to gather data for this study. The study participants were library practitioners affiliated with medical institutes and associated teaching hospitals in Pakistan. The questionnaires were disseminated to respondents through various channels,[1] including personal visits, social media platforms, emails, and Google docs. A total of 256 responses were received from library professionals out of the 369 institutions targeted, which were subsequently utilized for analysis. The collected data underwent a process of data screening and filling in missing values before being subjected to correlation analysis using the 26th version of the Statistical Package for the Social Sciences (SPSS).

Findings – The findings of the study indicated the correlations between 1) Technological, legal and ethical challenges with copyright law, personal data privacy, data security, fair use, software/ hardware inadequacy, storage limitation and data recovery; 2) Knowledge, skills and organizational challenges with data management, data retrieval, data cleaning, learning and utilization, funding, training and policy in medical libraries of Pakistan.

Originality/value – The present research holds substantial importance as it addresses a significant gap in the existing literature concerning the utilization of BDA in these libraries and the accompanying challenges experienced by librarians of these institutes. By focusing on this topic, the study contributes to the existing knowledge and understanding of the subject matter.

Keywords Big Data Analytics (BDA), Medical Institutes, healthcare, library practitioners, Challenges.

1. Introduction

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The emergence and advancement of modern technologies including Internet of Things (IoT), and cloud computing have led to the generation of vast amounts of data across various domains (Al-Talafhah, Aplop, Daradkeh, Wibawa, & Marniati, 2023). Ahmad, JianMing, and Rafi (2019b), assert that the rise of ICT and modern technologies have significantly increased the volume of digital objects worldwide. In this digital era, there is an overwhelming influx and proliferation of information (Guo & Chen, 2023). Ikegwu, Nweke, Anikwe, Alo, and Okonkwo (2022), accurately state that data is being produced at an exponential rate due to advancements in the internet, mobile technology, sensors, and cloud computing. Over the past two decades, big data has been comprehensively debated in different fields, and it is defined as the accumulation of data on an immense scale (Djafri, Bensaber, & Adjoudj, 2018). As Ahmed et al. (2017), highlights that big data has become a prominent topic of investigation in diverse areas such as health, business, education, commerce, games, and public departments. Numbers of researches have been carried out to address challenges and facilitate the execution of big data analytics (BDA). However, a universally accepted definition of big data has not yet been established. Several definitions are presented below: Anna and Mannan (2020), describes big data as datasets that exceed the capacity of common software, while Watson (2019), defines big data as large and complex datasets that conventional software is incapable of handling. Weerasinghe (2017), states that the emergence of new technologies has led to changes in the roles and responsibilities of library managers and professionals.Wu, Li, Liu, and Zheng (2017), argue that library practitioners and managers now have the responsibility to store and analyze existing data in information centers, enabling them to make informed decisions and predictions to achieve organizational goals. Moreover, the implementation of BDA can enhance process efficiency and effectiveness (Venkatesh & Davis, 2000). BDA encompasses technologies and techniques for capturing, storing, transmitting, analyzing, and visualizing vast amounts of structured and unstructured data (Erevelles, Fukawa, & Swayne, 2016). The implementation of new information systems in libraries poses inherent challenges for library professionals, as emphasized by (Fernando, Chidambaram, & Wahyuni-TD, 2018).

1.2 Libraries and Big Data Analytics (BDA)

Libraries play a crucial role in the field of Big Data Analytics (BDA) by providing essential resources and expertise to support data-driven research and analysis. In the era of big data, where vast amounts of information are generated and collected across various domains, libraries serve as key knowledge hubs that facilitate access to relevant datasets, tools, and methodologies for effective data analysis (Anna & Mannan, 2020). Likewise, Harisanty, Anna, Putri, Firdaus, and Noor Azizi (2022), argues that libraries play a vital role in acquiring, organizing, and disseminating information to satisfy society's thirst for knowledge. The influence of BD is transforming the structure and operations of information center to fulfill their responsibilities (Hamad, Fakhuri, & Abdel Jabbar, 2022). Presently, big data is revolutionizing the traditional approach of data provision by leveraging the techniques of big data analytics (BDA) to derive valuable insights (Ambigavathi & Sridharan, 2018). Libraries offer a diverse range of resources to support BDA initiatives. They provide access to extensive collections of scholarly journals, research papers, and books, which contain valuable insights into various domains and methodologies of data analysis. Additionally, libraries often subscribe to specialized databases and repositories that house large-scale datasets, such as government data, social media data, and scientific data, which are essential for conducting comprehensive and robust data analytics (Nahotko, Zych, Januszko-Szakiel, & Jaskowska, 2023). Libraries actively engage in the development and promotion of open data initiatives, fostering a culture of data sharing and collaboration. They advocate for the use of open data standards and licenses, ensuring that datasets are easily discoverable, accessible, and usable by researchers. Moreover, libraries support researchers in managing and preserving their own data through data curation services, which include data cleaning, organization, and long-term preservation, ensuring the reproducibility and integrity of data analysis (Ahmad, JianMing, & Rafi, 2019a). In summary, libraries play an integral role in the world of Big Data Analytics by

providing resources, expertise, and services that support data-driven research and analysis. Their extensive collections, specialized databases, and training programs empower researchers to explore and analyze large-scale datasets effectively. By promoting open data initiatives and offering data curation services, libraries contribute to the advancement of knowledge and facilitate collaboration in the field of big data analytics (He, 2023).

1.3 Healthcare Colleges and Affiliated Teaching Hospitals

This research considers medical institutes as educational institutions offering a range of medical programs such as MBBS, BDS, Nursing, DPT, and Homeopathic, among others. These institutes are affiliated with a recognized Medical University, formerly known as the Pakistan Medical and Dental Council (PMDC) (PMDC, 2019). According to Ullah and Anwar (2013), the term "medical libraries" refers to the libraries located within these medical institutions and their associated teaching hospitals in Pakistan. In the era of rapid digital advancements, the adoption of data analytics has become crucial for libraries in educational institutions. This shift can be attributed to the proliferation of emerging technologies, the exponential growth of digital innovations, and the increased reliance on digital resources (Islam, Ahmad, Rafi, & JianMing, 2020).

According to PMDC (2019), the country has a total of 369 medical colleges and their affiliated hospitals. Among them, 118 colleges and hospitals are situated in the province of Khyber Pakhtunkhwa. These are offering a diverse range of medical programs including professional degree programs and paramedics programs (University, 2020, September 11). In Punjab, there are 156 medical institutes, 76 in Sindh, and 07 in Baluchistan province. Moreover, Azad Jammu and Kashmir has 12 medical colleges and associated hospitals (University, 2020, Septembe, 11); See Appendix- I for further details).

Medical library patrons play a crucial role in safeguarding human lives (Gomes, Kovaleski, Pagani, da Silva, & Pasquini, 2023). These individuals depend on up-to-date, precise, and pertinent data to satisfy their everyday information requirements. Leveraging the capabilities of BDA, it becomes feasible to supply information to these concerned users in a meticulously structured manner tailored to their specific demands (Berros, El Mendili, Filaly, & El Bouzekri El Idrissi, 2023). Furthermore, this technological approach can serve as a powerful instrument to enhance the efficacy with which medical practitioners, educators, students, researchers, and paramedical personnel are supported (Rehman, Naz, & Razzak, 2022). The primary aim of this research endeavor is to investigate the various obstacles and impediments encountered by library practitioners in medical institutions in the adoption and implementation of BDA technology (Batko & Ślęzak, 2022). This investigation is prompted by the significant transformations experienced by library professionals, who have assumed roles beyond traditional custodianship or guardianship of information materials (Karatas, Eriskin, Deveci, Pamucar, & Garg, 2022). Presently, their responsibilities encompass data management, data science, as well as the storage and retrieval of information (Fanelli, Pratici, Salvatore, Donelli, & Zangrandi, 2023). Furthermore, the need to incorporate BDA systems within medical libraries has become increasingly essential for facilitating informed decision-making, forecasting future trends, and optimizing the overall efficacy of library operations (Pramanik, Pal, & Mukhopadhyay, 2022). The present study aims to elucidate a comprehensive set of challenges confronted by library professionals in medical institutions and affiliated teaching hospitals as they navigate the complexities associated with this novel information system.

1.4. Research Objectives

The following objectives are set for this study:

1. To analyze the correlation between the Technological, legal and ethical challenges faced by medical libraries in implementing Big Data Analytics.
2. To analyze the correlation between the Knowledge, skills and organizational challenges faced by medical libraries in implementation Big Data Analytics.
3. To explore the effectiveness of using Big Data Analytics in the medical libraries of Pakistan.

2. Review of Literature

The purpose of this section is to review the existing literature pertaining to big data, big data analytics, and the challenges encountered by medical librarians during the implementation of this new technology. By examining prior research and scholarly works, this review will provide a comprehensive overview of the current knowledge and gaps in understanding regarding these topics. This literature review will serve as the foundation for the subsequent sections of the research study

2.1. Big Data (BD)

The determination of the threshold at which data is considered "big" remains an open query, subject to varying viewpoints among data scientists. Some argue that Big Data (BD) encompasses data on the scale of exabytes, while others propose zettabytes or yottabytes (Khanna, Jindal, Singh, & Rana, 2023). Diverse experts have presented their own perspectives on this concept, supported by evidence. For instance, Guo and Chen (2023) characterizes BD as information resources with high volume, high velocity, and/or high variety, requiring cost-effective and ground-breaking approaches to information dispensation. This enables improved insight, decision-making, and automation processes. The origins of the term "Big Data" have also been subject to discussion and analysis. According to Diebold et al. (2012), the term "Big Data" was first used by John Mashey in a meeting in Silicon Graphics Inc. (SGI) in 90s. However, Batistič and van der Laken (2019), assert that Michael Cox and David Ellsworth were the first to use the term in IEEE conference around 1997. Pastorino et al. (2019), emphasize the significance of volume, velocity, and variety as the three primary characteristics of BD. Building upon this definition, Schaeffer and Olson (2014), further highlight the potential for value creation associated with BD. Hence, in this study, Big Data (BD) is defined as data characterized by high value, volume, velocity, variety, and veracity, taking into account data quality as well (White, 2012). The IDC Corporation report reveals that the size of the data experienced a nine-fold increase over a five-year period, reaching 1.8ZB. Furthermore, the report projects a doubling in data volume after each two years until 2020 (Batko & Ślęzak, 2022).

2.2 Big Data Analytics (BDA)

BDA includes a range of technologies and skills used to hunt, store, disseminate, evaluate, and visualize vast amounts of both structured and unstructured data (Talaoui, Kohtamäki, Ranta, & Paroutis, 2023). The active utilization of BDA has the potential to greatly impact various aspects of the global economy (Joubert, Murawski, & Bick, 2023). Similarly, define BDA as a collection of data management and analytical techniques and skills designed to handle massive amounts of data (ranging from terabytes to exabytes) and diverse data types (from sensors to social media). The successful implementation of the BDA structure relies on innovative technologies for data storage, management, analysis, and visualization. Overcoming challenges related to data capture, storage, analysis, and visualization has led to a drastic change in the field of data recovery and analysis (Bose, Dey, & Bhattacharjee, 2023). Cricket serves as a notable example highlighting the application of BDA. During international cricket tournaments, past data is readily available for easy analysis, enabling the evaluation of a batter's or bowler's performance in real-time (Dhyani & Barthwal, 2014). Although data providers may encounter challenges in acquiring, storing, and processing information, the growing interest in Big Data analytics (BDA) is expected to minimize these issues and lead to faster problem

resolution (Dalaklis, Nikitakos, Papachristos, & Dalaklis, 2023). Although data providers may encounter challenges in acquiring, storing, and processing information, the growing interest in BDA is expected to minimize these issues and lead to faster problem resolution (De Mauro, Greco, & Grimaldi, 2015).

2.3 Big Data Analytics Challenges

While the adoption of BDA has facilitated seamless operations and simplified tasks for employees within organizations and institutes, it also presents certain challenges that they must confront and address (Naeem et al., 2022).

3.3.1   Technological and Legal & Ethical Challenges

In terms of technological challenges, the provision of modern machines, technological tools, hardware, and software are critical factors to consider (Sivarajah, Kamal, Irani, & Weerakkody, 2017). Additionally, determining which data should be stored and which data points are important poses a significant challenge in data management (Hariri, Fredericks, & Bowers, 2019); (Qi, Xu, & Rani, 2023), specific technological skills are required to effectively manage and store Big Data Analytics (BDA). In addition, the technical challenges associated with Big Data (BD) storage are underscored by their significant cost and complexity (Fawzy, Moussa, & Badr, 2022).

Future researchers will encounter numerous challenges that necessitate careful consideration. One such challenge pertains to the establishment of robust analytics architecture capable of effectively managing both contemporary and historical data (Kastouni & Lahcen, 2022). Ensuring statistical significance is also an arduous task, particularly when grappling with voluminous data sets and multifarious inquiries (Lutfi et al., 2022). Moreover, researchers must devise adaptable systems capable of accommodating dynamic data transformations over time. Managing the storage and administration of large-scale data poses yet another formidable challenge, prompting researchers to explore options such as compression and sampling (Gama, 2010). The visualization of data analysis outcomes is additionally problematic due to the overwhelming abundance of information involved. Lastly, a substantial reservoir of valuable data remains concealed and unexamined due to inadequate tagging and analysis protocols. Addressing these challenges necessitates the adoption of innovative approaches and techniques that can effectively surmount the obstacles at hand (Feldman, Schmidt, & Sohler, 2020; Gantz & Reinsel, 2012).

On the other hand, legal and ethical challenges are an integral part of Big Data Analytics. Privacy and security are major concerns with big data, encompassing legal, technical, and conceptual implications(Paul, Maglaras, Ferrag, & AlMomani, 2023). Likewise, Kamalov, Pourghebleh, Gheisari, Liu, and Moussa (2023) expounded on the significance of Privacy and Security as two crucial challenges and issues in the realm of big data. These aspects encompass legal, technical, and conceptual importance, as they pertain to the sensitive nature of personal information. Certain individuals are reluctant to share their private information or compromise their confidentiality, particularly when BDA involve the amalgamation of personal information with large datasets, potentially unveiling new insights about individuals' personal information (Hasan et al., 2022). Many organizations use personal information for business purposes, which raises concerns about privacy and the need for informed consent (Shi, 2022). Additionally, the application of big data analytics can lead to social stratification, where individuals with higher education and access to predictive analyses benefit more than those who are less literate (Quadir, Chen, & Isaias, 2022). Sharing personal data and processes within large systems can also compromise privacy and competitiveness, challenging the culture surrounding these issues.

3.3.2   Knowledge & Skills Challenges and Organizational Challenges

The advancement of the library profession encounters substantial challenges related to knowledge and skills (Pimentel & Pimentel, 2019). A significant number of library professionals exhibit limited awareness and proficiency in modern IT environments due to

restricted access to pertinent training opportunities. This dearth of up-to-date IT skills inhibits the effective application of Big Data analytics (BDA) within library settings. The insufficiency of data handling capabilities and the inadequate skill set possessed by librarians present formidable obstacles in the implementation of BDA (Ikegwu et al., 2022). Additionally, the generation of accurate metadata for data labeling poses a methodological challenge in BDA (Arooj et al., 2022). The organizational aspects and analytical aspects of BDA are confronted with additional critical challenges stemming from the inherent characteristics of the data itself, characterized by its extensive magnitude, variability, and dynamism (El Khatib, Hamidi, Al Ameeri, Al Zaabi, & Al Marqab, 2022).

Beyond the knowledge and skills challenges, organizational hindrances impede the seamless implementation of BDA. The inadequacy of infrastructural facilities curtails employee engagement and interest in their work within the library environment (Ilesanmi, 2013). Key factors that significantly affect the successful integration of BDA encompass upper management guidance, pecuniary resources, information resources, techniques, usefulness, and technical capabilities, as highlighted by (I. Lee & Mangalaraj, 2022). These factors are observed from the perspective of the resource-based approach. Furthermore, the storage space required to accommodate the prodigious volume of data emanating from diverse sources, encompassing social media platforms and databases, presents a substantial demand for storage devices (C. H. Lee & Yoon, 2017). Cloud computing has been posited as a viable solution; however, the process of uploading massive data sets onto the cloud engenders significant effort and time consumption. Consequently, an alternative resolution to this predicament entails uploading solely the metadata of the voluminous data onto clouds and networks (Rawson & Brito, 2023).

3. Methodology

The study in hand used quantitative research design which employs numerical data and statistical analysis to investigate relationships and patterns. It emphasizes objective measurement, control over variables, and generalizability of findings. By collecting and analyzing data through surveys, it aims to uncover meaningful insights and make evidence-based conclusions (Mathivha, 2023).

3.1 Data collection and instrumentation

According to PMDC (2019), a total of 369 healthcare colleges and associated hospitals were identified in the country. To gather data, a data collection tool was administered to library professionals employed in these colleges and hospitals. The instrument was developed based on previous literature in the field and validated by two experts specializing in BDA. Its reliability was assessed using SPSS 26, which indicated excellent reliability with a Cronbach's Alpha value of 0.942 (Kennedy, 2022). The questionnaire encompassed items pertaining to technological challenges, knowledge and skills challenges, legal and ethical challenges, and organizational challenges. Respondents recorded their responses on a 5-point Likert scale. The items of the constructs were derived from the existing scholarly works. The data collection tool was disseminated to respondents through diverse channels, including visit in person, social media, postal mail, and Google Docs. After collecting 256 responses back, out of the entire population of 369, were considered for analysis.

4. Data Analysis and Results

Furthermore, an extensive correlational analysis using SPSS version 26 is conducted on the collected data to explore challenges related to technology, knowledge and skills, legal and ethical issues, and organizational challenges. This analysis helps identify the main obstacles and problems encountered in the study context. The data collection process focused on obtaining census-based data due to the limited population. Out of a total of 369 respondents, 256 responses were received for data analysis, accounting for 69.37% of the total sample. The

gender distribution revealed 74 females and 182 males. In terms of qualifications, 8 (3.1%) held a PhD degree, 56 (21.9%) had an MS/MPhil degree, 189 (73.8%) possessed an MLIS/BSLIS degree, and 3 (1.2%) held a BLIS degree. Geographically, the respondents represented various regions as shown in Table 1. Among them, 147 (57.4%) were from the private sector, while 109 (42.6%) were from the government sector. When considering professional experience, different group numbers are given in table 1.

		Frequency	Percentage %
Gender	Male	182	71.09%
	Female	74	28.90%
Qualification	PhD	8	3.1%
	MS/MPhil	56	21.9%
	MLIS/BS-LIS	189	73.8%
	BLIS	3	1.2%
Location of Institution	Punjab	103	40.2%
	Sindh	39	15.2%
	Baluchistan	6	2.3%
	Khyber Pakhtunkhwa	92	35.9%
	Federal Capital & AJ Kashmir	16	6.3%
Type of Institution		109	42.6%
	Public		
	Private	147	57.4%
Experience		85	33.2%
	1- 5 Years		
	6-10 Years	78	30.5%
	11-15 Years	53	20.7%
	16-20 Years	17	6.6%
	More than 20 Years	23	9.0%

Table 1. Demographic Information

5. Analysis and Discussion on Various Challenges of Big Data Analytics

Big Data Analytics has emerged as a powerful tool for extracting insights and driving informed decision-making across various industries (Singh, Agrawal, Sahu, & Kazancoglu, 2023). However, the adoption and effective utilization of BDA face several challenges (Qi et al., 2023). This note explores some of the prominent challenges, including legal and ethical considerations, technological constraints, knowledge and skills gaps, and organizational hurdles. The data pertaining to the construct of challenges has been gathered from the respondents, focusing on the four main domains: 1) Technological Challenges, 2) Legal and Ethical Challenges, 3) Knowledge and Skills Challenges and 4) Organizational Challenges. Thes domains further divided in two main sets of challenges: 1) Technological, Legal and Ethical Challenges, and 2) Knowledge, Skills and Organizational Challenges. The data was gathered as per these two main sets of challenges from the respondent (Nti, Quarcoo, Aning, & Fosu, 2022). Likewise, two sets of four types of challenges were identified: 1) Legal and Ethical challenges and Technological challenges, and 2) Knowledge and Skills challenges and Organizational Skills challenges.

5.1 Level of significance (p <0.005), **represents significance, Variables 08

Table 2 provides empirical evidence indicating a noteworthy correlation among all eight variables pertaining to Legal and Ethical and Technological Challenges within the context of BDA. This correlation analysis is based on the challenges encountered by medical librarians in their respective libraries while striving for the seamless implementation and utilization of BDA.

In line with the findings, Guo and Chen (2023) research emphasizes the existence of diverse challenges faced by adopters of BDA during its implementation. These challenges are recognized as significant obstacles hindering the smooth integration of this emerging technology (Khanna et al., 2023).

The statistical findings depicted in Table 4.9 reveal a positive correlation between the aforementioned categories of challenges, as evidenced by the fulfillment of the requisite P-value criteria. The correlation analysis of the eight variables associated with legal and ethical challenges, alongside technological challenges, is presented as follows:

Table 2. Correlation among items of Legal and Ethical and Technological Challenges.

	1.Copyright	2.Privacy	3.Data Security	4.Fair Use	5.Software and Hardware	6.Storage Devices	7.Data Recovery
2	.683**						
	.000						
3	.654**	.731**					
	.000	.000					
4	.497**	.626**	.648**				
	.000	.000	.000				
5	.391**	.411**	.414**	.322**			
	.000	.000	.000	.000			
6	.403**	.434**	.407**	.394**	.806**		
	.000	.000	.000	.000	.000		
7	.414**	.470**	.441**	.433**	.627**	.655**	
	.000	.000	.000	.000	.000	.000	
8	.435**	.513**	.416**	.500**	.579**	.672**	.732**
	.000	.000	.000	.000	.000	.000	.000

**. Correlation is significant at the 0.01 level (2-tailed)

- Copyright Laws (1) show a significant correlation with personal data privacy and copyright (2), issues of data security (3), fair use (4), lack of proper software and hardware (5), lack of storage device (6), data recovery (7), and variation in data types (8).
- Personal data privacy (2) exhibits a significant correlation with copyright laws (1), issues of data security (3), fair use (4), lack of proper software and hardware (5), and lack of storage device (6), data recovery (7), and variation in data types (8).
- Issues of data security (3) demonstrate a significant correlation with copyright laws (1), personal data privacy and copyright (2), fair use (4), lack of proper software and hardware (5), lack of storage device (6), data recovery (7), and variation in data types (8).
- Fair use (4) displays a significant correlation with copyright laws (1), personal data privacy and copyright (2), issues of data security (3), lack of proper software and hardware (5), lack of storage device (6), data recovery (7), and variation in data types (8).
- Lack of proper software and hardware (5) is significantly correlated with copyright laws (1), personal data privacy and copyright (2), issues of data security (3), fair use (4), lack of storage device (6), data recovery (7), and variation in data types (8).

- Lack of storage device (6) demonstrates a positive significant correlation with copyright laws (1), personal data privacy and copyright (2), issues of data security (3), fair use (4), data recovery (7), and variation in data types (8).
- Data recovery (7) exhibits a significant correlation with copyright laws (1), personal data privacy and copyright (2), issues of data security (3), fair use (4), lack of proper software and hardware (5), lack of storage device (6), and variation in data types (8).
- Variation in data types (8) shows a significant correlation with copyright laws (1), personal data privacy and copyright (2), issues of data security (3), fair use (4), lack of proper software and hardware (5), lack of storage device (6), and data recovery (7).

These results highlight the interconnectedness of these variables and emphasize the need for comprehensive approaches to address challenges related to copyright, data privacy, security, fair use, software and hardware infrastructure, storage devices, data recovery, and data types. Ahmad et al. (2019a), Carried out a study on the competencies and skills of academic librarians in relation to the implementation of Big Data Analytics (BDA). The researchers employed Pearson Correlation to investigate the relationship between different aspects of academic librarians' skills and competencies. Current research is warranted to develop effective strategies and frameworks for managing data while adhering to legal and ethical requirements (Kaisler, Espinosa, Money, & Armour, 2023). These empirical insights shed light on the intricate fabric of challenges encountered in the realm of copyright, data privacy, security, fair use, software and hardware infrastructure, storage devices, data recovery, and data types. In the study of Ofe, De Reuver, Nederstigt, and Janssen (2023), conducted a study focusing on "small hospitality businesses," wherein they identified and highlighted various technological and ethical challenges that pose obstacles to the effective implementation of BDA. The findings emphasize the necessity for a comprehensive and holistic approach in addressing these multifaceted issues. They underscore the importance of formulating robust strategies, frameworks, and policies that encompass the intricate web of factors implicated in the smooth and effective management of data while upholding legal and ethical obligations (Naeem et al., 2022).

Consequently, it is evident that further in-depth investigation and scholarly research are imperative to deepen our understanding and develop comprehensive solutions that navigate the complex landscape of copyright-related concerns, data privacy, security, fair use practices, software and hardware infrastructure, storage device provisions, data recovery methodologies, and the intricacies of data types (Vaidya & Kshirsagar, 2023). Such scholarly endeavors will contribute to the advancement of knowledge, the formulation of best practices, and the establishment of a solid foundation for the prudent and ethically sound management of data in various domains.
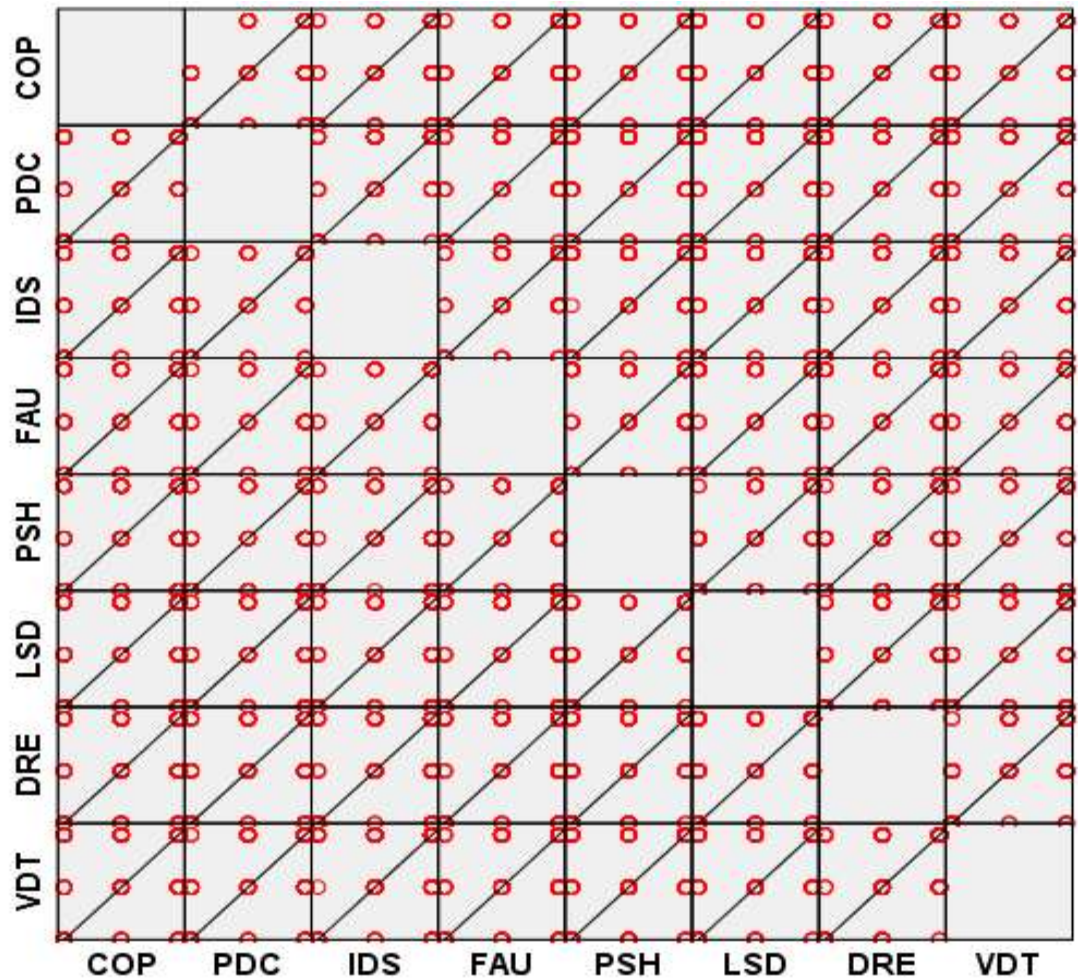
Figure 1. Scatter plot matrix for correlation of Legal & Ethical and Technological variables

The scatter plot matrix displayed in Figure 1 demonstrated a positive correlation among the factors examined in the study. The presence of straight lines in the plot signifies that alterations in one factor will consistently and proportionally impact other factors in the same direction. Likewise, when a factor experiences an increase or decrease, the other factors will undergo a simultaneous and proportional change of a comparable magnitude.

5.2 Level of significance (p <0.005), **represents significance, Variables 08

The result presented in Table 3 reveals a significant correlation among all eight variables of Knowledge and Skills and Organizational challenges in the context of BDA implementation in medical libraries. This correlation highlights the interdependence of these variables and emphasizes the impact of organizational challenges on the effective utilization of BDA.

The positive correlation between Knowledge and Skills and Organizational challenges indicates that the presence of these challenges hampers the successful implementation of BDA in medical libraries (Ahmad et al., 2019a). The P-values of the correlation coefficients confirm the statistical significance of these relationships, further strengthening the validity of the findings (O'Kelly, Jeffryes, Hobscheid, & Passarelli, 2023).

. **Table 3.** Correlation among items of Knowledge & Skills and Organizational Challenges

	1.Data Management	2.Data Retrieval	3.Data Cleansing	4.Learning & Utilizing	5.Funding	6.Training	7.Policy
2	.767** .000						
3	.663** .000	.649** .000					
4	.459** .000	.480** .000	.505** .000				
5	.456** .000	.429** .000	.451** .000	.309** .000			
6	.515** .000	.524** .000	.510** .000	.385** .000	.662** .000		
7	.546** .000	.587** .000	.524** .000	.408** .000	.671** .000	.763** .000	
8	.521** .000	.540** .000	.562** .000	.417** .000	.656** .000	.728** .000	.787** .000

**. Correlation is significant at the 0.01 level (2-tailed

- The lack of data management skills (1) exhibits a significant correlation with multiple factors, including the absence of data retrieval capabilities (2), challenges associated with data cleansing (3), limited interest among LIS professionals in learning and utilizing big data tools (4), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities for LIS professionals (6), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).
- Difficulties in data retrieval (2) demonstrate a noteworthy correlation with several factors, such as the deficiency in data management skills (1), challenges related to data cleansing (3), the limited interest of LIS professionals in acquiring and employing big data tools (4), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities for LIS professionals (6), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).
- Data cleansing (3) exhibits a significant correlation with various factors, including the lack of data management skills (1), challenges associated with data retrieval (2), the limited interest of LIS professionals in learning and utilizing big data tools (4), inadequate funding for data warehouse projects (5), insufficient provision of training opportunities for LIS professionals (6), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).
- The limited interest and utilization of big data tools among LIS professionals (4) are significantly correlated with factors such as the deficiency in data management skills (1), challenges related to data retrieval (2), difficulties in data cleansing (3), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities for LIS professionals (6), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).
- Inadequate funding for data warehouse projects (5) demonstrates a significant correlation with factors such as the deficiency in data management skills (1), challenges associated with data retrieval (2), difficulties in data cleansing (3), the limited interest of LIS professionals in learning and utilizing big data tools (4), insufficient provision of training opportunities for LIS professionals (6), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).
- The absence of provision for training opportunities for LIS professionals (6) is significantly correlated with factors such as the deficiency in data management skills (1), challenges associated with data retrieval (2), difficulties in data cleansing (3), the

limited interest of LIS professionals in learning and utilizing big data tools (4), inadequate funding for data warehouse projects (5), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).

- The lack of a BD Management Policy (7) strongly correlates with factors such as the deficiency in data management skills (1), challenges related to data retrieval (2), difficulties in data cleansing (3), the limited interest of LIS professionals in learning and utilizing big data tools (4), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities for LIS professionals (6), and the presence of administrative barriers (8).

- Administrative barriers (8) strongly correlate with factors such as the deficiency in data management skills (1), challenges associated with data retrieval (2), difficulties in data cleansing (3), the limited interest of LIS professionals in learning and utilizing big data tools (4), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities for LIS professionals (6), the absence of a BD Management Policy (7), and the presence of administrative barriers (8).

The aforementioned research outcomes offer significant contributions towards understanding the intricate interconnections among diverse variables that impact data management, specifically with regards to skills, as indicated by Al-Talafhah et al. (2023) in their recent study. This investigation explored a positive and substantial correlation between skills and data management, shedding light on the inherent relationship between these two constructs. To conclude, the lack of data management skills in the field exhibits a significant correlation with various factors, such as the absence of data retrieval capabilities, challenges in data cleansing, limited interest among LIS professionals in utilizing big data tools, insufficient funding for data warehouse projects, inadequate provision of training opportunities, the absence of a Big Data Management Policy, and the presence of administrative barriers. This result has also been supported by Aseeri and Kang (2023) in their study related to organizational culture and BDA. These interconnected challenges highlight the importance of addressing the skills gap, promoting knowledge acquisition, and establishing supportive policies to enhance data management practices (Hirschlein, Meckenstock, & Dremel, 2022). By addressing these factors, organizations and professionals can better navigate the complexities of data management and leverage the potential of big data for informed decision-making and improved outcomes (Ikegwu et al., 2022).
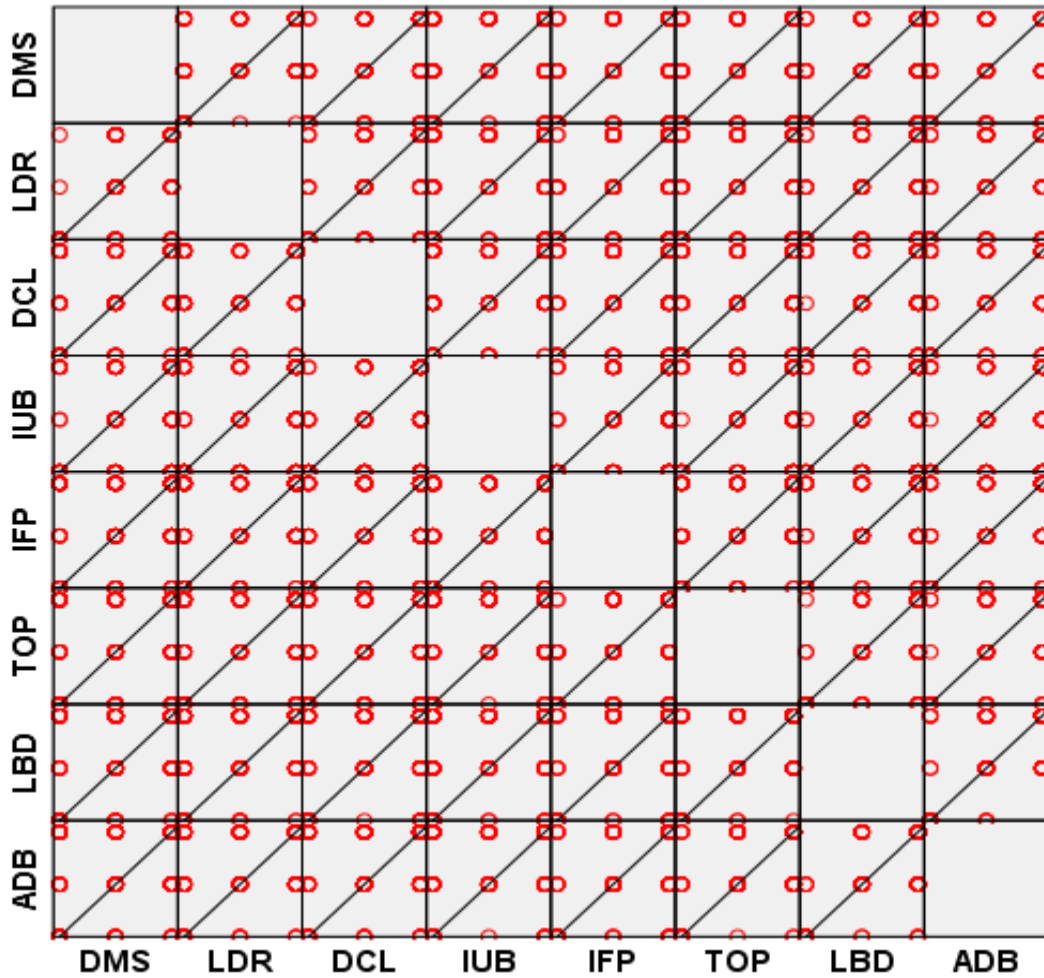
Figure 2. Scatter plot matrix for correlation of Knowledge & Skills and Organizational variables

The correlation scatter plot matrix in Figure 2 revealed that the factors included in the study are positively correlated. The straight lines depicted in the plot indicate that a change in one factor will have a corresponding effect on other factors in the same direction and with a similar magnitude. Similarly, if a factor increases or decreases, there will be a simultaneous increase or decrease of approximately the same amount in the other factors.

6. Findings and Recommendations

The findings of the correlation analysis indicate several significant relationships between various challenges in the implementation and analysis of BDA in medical libraries of Pakistan. Copyright laws were found to be significantly correlated with issues such as personal data privacy and copyright, data security, fair use, lack of proper software and hardware, variation in data type, data recovery, and lack of storage devices. Personal data privacy also exhibited significant correlations with these challenges, emphasizing the interplay between legal frameworks and privacy concerns. Data security challenges were found to be closely related to copyright laws, personal data privacy, fair use, and other factors, highlighting the importance of safeguarding sensitive information. Moreover, the lack of proper software and hardware and inadequate storage devices emerged as key obstacles, indicating the need for infrastructure improvements. Additionally, challenges related to data recovery and variation

in data types were identified as significant concerns in the context of medical libraries' big data analytics effort.

Similarly, in the context of Knowledge & Skills and Organizational challenges, The correlation analysis indicate several significant relationships among the factors related to data management skills, data retrieval, data cleansing, interest in big data tools, funding for data warehouse projects, provision of training opportunities, presence of a BD Management Policy, and administrative barriers. It was observed that the lack of data management skills (1) is correlated with the absence of data retrieval capabilities (2), challenges in data cleansing (3), limited interest in acquiring and utilizing big data tools (4), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities (6), absence of a BD Management Policy (7), and the presence of administrative barriers (8). Similarly, difficulties in data retrieval (2) were found to be correlated with factors such as the deficiency in data management skills (1), challenges in data cleansing (3), limited interest in big data tools (4), insufficient funding for data warehouse projects (5), inadequate provision of training opportunities (6), absence of a BD Management Policy (7), and the presence of administrative barriers (8).

Based on the findings, several recommendations can be proposed to address the challenges identified in the implementation and analysis of BDA in medical colleges of the country. Firstly, it is crucial to establish a comprehensive understanding and compliance with copyright laws to ensure the legal and ethical use of data. This involves developing policies and guidelines that promote data privacy and copyright protection while enabling efficient data analysis. Secondly, data security measures should be enhanced through the adoption of robust security protocols, encryption techniques, and regular security audits to protect sensitive patient information. Thirdly, investment in appropriate software and hardware infrastructure is vital to support efficient data processing, storage, and retrieval. Adequate funding should be allocated to acquire and maintain up-to-date technology resources. Fourthly, measures should be taken to address the storage challenges by implementing scalable and reliable data storage solutions, including cloud-based services, to accommodate the growing volume of medical data. Additionally, data recovery mechanisms should be established to ensure data resilience and continuity in case of system failures or data loss. Lastly, efforts should be made to promote data management skills among library and information science professionals by providing training programs and workshops on big data analytics tools and techniques. This will enable librarians to effectively handle and analyze complex datasets. Furthermore, the formulation and implementation of a Big Data Management Policy can provide a framework for data governance, standardization, and best practices. Overcoming administrative barriers, such as bureaucratic procedures and lack of support, is also crucial to foster a conducive environment for implementing and utilizing big data analytics in medical libraries.

These findings suggest that addressing the deficiency of data management skills and improving data retrieval capabilities are crucial for effective data management. Additionally, attention should be given to overcoming challenges in data cleansing, promoting interest and utilization of big data tools, securing sufficient funding, providing training opportunities, developing a BD Management Policy, and reducing administrative barriers. Implementing these recommendations can enhance data management practices and mitigate the identified challenges in the field.

7. Conclusion
Big Data Analytics plays a crucial role in facilitating informed decision-making, future prediction, streamlining processes, and ensuring efficiency and cost-effectiveness in information systems. The implementation and adoption of Big Data Analytics in medical institutes and teaching hospitals are essential and highly relevant in today's context. The users

of medical institute libraries, who are often involved in saving lives, require access to information in a timely manner to make quick and well-informed decisions. Incorporating this modern information system into medical libraries will enable them to meet these needs effectively. In conclusion, the findings of this study, supported by correlation analysis, revealed significant relationships and challenges associated to the application and analysis of BDA in these colleges of the country. The correlation analysis highlighted the interconnections among various factors, such as copyright laws, personal data privacy, data security, software and hardware deficiencies, storage limitations, data recovery, variation in data types, data management skills, data retrieval, data cleansing, interest in big data tools, funding, training, policy presence, and administrative barriers. These correlations emphasized the multifaceted nature of challenges faced in the BDA implementation process. To address these challenges, several key recommendations are proposed, including establishing compliance with copyright laws, enhancing data security measures, investing in appropriate infrastructure, promoting data management skills through training, formulating a Big Data Management Policy, and overcoming administrative barriers. By implementing the above recommendations, medical institute libraries in Pakistan can navigate the complexities associated with BDA implementation, improve data management practices, and effectively utilize big data analytics to advance healthcare outcomes.

Reference

Ahmad, K., JianMing, Z., & Rafi, M. (2019a). An analysis of academic librarians competencies and skills for implementation of Big Data analytics in libraries. Data Technologies and Applications.

Ahmad, K., JianMing, Z., & Rafi, M. (2019b). Librarian's perspective for the implementation of big data analytics in libraries on the bases of lean-startup model. Digital Library Perspectives.

Ahmed, E., Yaqoob, I., Hashem, I. A. T., Khan, I., Ahmed, A. I. A., Imran, M., & Vasilakos, A. V. (2017). The role of big data analytics in Internet of Things. Computer Networks, 129, 459-471.

Al-Talafhah, K. M. A., Aplop, F., Daradkeh, M., Wibawa, M. B., & Marniati, M. (2023). Big data analytics and healthcare performance: A unified model. Paper presented at the AIP Conference Proceedings.

Ambigavathi, M., & Sridharan, D. (2018). Big Data Analytics in Healthcare. Paper presented at the 2018 Tenth International Conference on Advanced Computing (ICoAC).

Anna, N. E. V., & Mannan, E. F. (2020). Big data adoption in academic libraries: a literature review. Library Hi Tech News, 37(4), 1-5. doi: 10.1108/LHTN-11-2019-0079

Arooj, A., Farooq, M. S., Akram, A., Iqbal, R., Sharma, A., & Dhiman, G. (2022). Big data processing and analysis in internet of vehicles: architecture, taxonomy, and open research challenges. Archives of Computational Methods in Engineering, 29(2), 793-829.

Aseeri, M., & Kang, K. (2023). Organisational culture and big data socio-technical systems on strategic decision making: Case of Saudi Arabian higher education. Education and Information Technologies, 1-26.

Batistič, S., & van der Laken, P. (2019). History, evolution and future of big data and analytics: A bibliometric analysis of its relationship to performance in organizations. British Journal of Management, 30(2), 229-251.

Batko, K., & Ślęzak, A. (2022). The use of Big Data Analytics in healthcare. Journal of Big Data, 9(1), 3.

Berros, N., El Mendili, F., Filaly, Y., & El Bouzekri El Idrissi, Y. (2023). Enhancing digital health services with big data analytics. Big data and cognitive computing, 7(2), 64.

Bose, S., Dey, S. K., & Bhattacharjee, S. (2023). Big data, data analytics and artificial intelligence in accounting: An overview. Handbook of Big Data Research Methods: 0, 32.

Dalaklis, D., Nikitakos, N., Papachristos, D., & Dalaklis, A. (2023). Opportunities and challenges in relation to big data analytics for the shipping and port industries. Smart Ports and Robotic Systems: Navigating the Waves of Techno-Regulation and Governance, 267-290.

De Mauro, A., Greco, M., & Grimaldi, M. (2015). What is big data? A consensual definition and a review of key research topics. Paper presented at the AIP conference proceedings.

Diebold, F. X., Cheng, X., Diebold, S., Foster, D., Halperin, M., Lohr, S., . . . Pospiech, M. (2012). A Personal Perspective on the Origin (s) and Development of "Big Data": The Phenomenon, the Term, and the Discipline∗.

Djafri, L., Bensaber, D. A., & Adjoudj, R. (2018). Big Data analytics for prediction: parallel processing of the big learning base with the possibility of improving the final result of the prediction. Information Discovery and Delivery.

El Khatib, M., Hamidi, S., Al Ameeri, I., Al Zaabi, H., & Al Marqab, R. (2022). Digital disruption and big data in healthcare-opportunities and challenges. ClinicoEconomics and Outcomes Research, 563-574.

Erevelles, S., Fukawa, N., & Swayne, L. (2016). Big Data consumer analytics and the transformation of marketing. Journal of Business Research, 69(2), 897-904.

Fanelli, S., Pratici, L., Salvatore, F. P., Donelli, C. C., & Zangrandi, A. (2023). Big data analysis for decision-making processes: challenges and opportunities for the management of health-care organizations. Management Research Review, 46(3), 369-389.

Fawzy, D., Moussa, S. M., & Badr, N. L. (2022). The internet of things and architectures of big data analytics: Challenges of intersection at different domains. Ieee Access, 10, 4969-4992.

Feldman, D., Schmidt, M., & Sohler, C. (2020). Turning big data into tiny data: Constant-size coresets for k-means, PCA, and projective clustering. SIAM Journal on Computing, 49(3), 601-657.

Fernando, Y., Chidambaram, R. R., & Wahyuni-TD, I. S. (2018). The impact of Big Data analytics and data security practices on service supply chain performance. Benchmarking: An International Journal.

Gama, J. (2010). Knowledge discovery from data streams: CRC Press.

Gantz, J., & Reinsel, D. (2012). The digital universe in 2020: Big data, bigger digital shadows, and biggest growth in the far east. IDC iView: IDC Analyze the future, 2007(2012), 1-16.

Gomes, M. A. S., Kovaleski, J. L., Pagani, R. N., da Silva, V. L., & Pasquini, T. C. d. S. (2023). Transforming healthcare with big data analytics: technologies, techniques and prospects. Journal of Medical Engineering & Technology, 47(1), 1-11.

Guo, C., & Chen, J. (2023). Big data analytics in healthcare Knowledge Technology and Systems: Toward Establishing Knowledge Systems Science (pp. 27-70): Springer.

Hamad, F., Fakhuri, H., & Abdel Jabbar, S. (2022). Big data opportunities and challenges for analytics strategies in Jordanian Academic Libraries. New review of academic librarianship, 28(1), 37-60.

Hariri, R. H., Fredericks, E. M., & Bowers, K. M. (2019). Uncertainty in big data analytics: survey, opportunities, and challenges. Journal of Big Data, 6(1), 1-16.

Harisanty, D., Anna, N. E. V., Putri, T. E., Firdaus, A. A., & Noor Azizi, N. A. (2022). Leaders, practitioners and scientists' awareness of artificial intelligence in libraries: a pilot study. Library Hi Tech.

Hasan, M. K., Alkhalifah, A., Islam, S., Babiker, N. B., Habib, A. A., Aman, A. H. M., & Hossain, M. A. (2022). Blockchain technology on smart grid, energy trading, and big data: security issues, challenges, and recommendations. Wireless Communications and Mobile Computing, 2022, 1-26.

He, M. (2023). Application of Big Data Analysis in Personalized Service Management of University Libraries. Paper presented at the Information and Knowledge Management.

Hirschlein, N., Meckenstock, J.-N., & Dremel, C. (2022). Towards Bridging the Gap Between BDA Challenges and BDA Capability: A Conceptual Synthesis Based on a Systematic Literature Review. Paper presented at the Proceedings of the 55th Hawaii International Conference on System Sciences.

Ikegwu, A. C., Nweke, H. F., Anikwe, C. V., Alo, U. R., & Okonkwo, O. R. (2022). Big data analytics for data-driven industry: a review of data sources, tools, challenges, solutions, and research directions. Cluster Computing, 25(5), 3343-3387.

Ilesanmi, T. C. (2013). Roles of the librarian in a research library in the digital era: Challenges and the way forward. New review of academic librarianship, 19(1), 5-14.

Islam, A. A., Ahmad, K., Rafi, M., & JianMing, Z. (2020). Performance-based evaluation of academic libraries in the big data era. Journal of Information Science, 0165551520918516.

Joubert, A., Murawski, M., & Bick, M. (2023). Measuring the big data readiness of developing countries–index development and its application to Africa. Information Systems Frontiers, 25(1), 327-350.

Kaisler, S., Espinosa, J. A., Money, W., & Armour, F. (2023). Big Data and Analytics: Issues and Challenges for the Past and Next Ten Years.

Kamalov, F., Pourghebleh, B., Gheisari, M., Liu, Y., & Moussa, S. (2023). Internet of medical things privacy and security: Challenges, solutions, and future trends from a new perspective. Sustainability, 15(4), 3317.

Karatas, M., Eriskin, L., Deveci, M., Pamucar, D., & Garg, H. (2022). Big Data for Healthcare Industry 4.0: Applications, challenges and future perspectives. Expert Systems with Applications, 200, 116912.

Kastouni, M. Z., & Lahcen, A. A. (2022). Big data analytics in telecommunications: Governance, architecture and use cases. Journal of King Saud University-Computer and Information Sciences, 34(6), 2758-2770.

Kennedy, I. (2022). Sample size determination in test-retest and Cronbach alpha reliability estimates. British Journal of Contemporary Education, 2(1), 17-29.

Khanna, D., Jindal, N., Singh, H., & Rana, P. S. (2023). Applications and Challenges in Healthcare Big Data: A Strategic Review. Current Medical Imaging, 19(1), 27-36.

Lee, C. H., & Yoon, H.-J. (2017). Medical big data: promise and challenges. Kidney research and clinical practice, 36(1), 3.

Lee, I., & Mangalaraj, G. (2022). Big data analytics in supply chain management: A systematic literature review and research directions. Big data and cognitive computing, 6(1), 17.

Lutfi, A., Alsyouf, A., Almaiah, M. A., Alrawad, M., Abdo, A. A. K., Al-Khasawneh, A. L., . . . Saad, M. (2022). Factors influencing the adoption of big data analytics in the digital transformation era: Case study of Jordanian SMEs. Sustainability, 14(3), 1802.

Mathivha, D. T. (2023). A Dynamic Capabilities Perspective of Big Data Analytics in Healthcare in South Africa.

Naeem, M., Jamal, T., Diaz-Martinez, J., Butt, S. A., Montesano, N., Tariq, M. I., . . . De-La-Hoz-Valdiris, E. (2022). Trends and future perspective challenges in big data. Paper presented at the Advances in Intelligent Data Analysis and Applications: Proceeding of the Sixth Euro-China Conference on Intelligent Data Analysis and Applications, 15–18 October 2019, Arad, Romania.

Nahotko, M., Zych, M., Januszko-Szakiel, A., & Jaskowska, M. (2023). Big data-driven investigation into the maturity of library research data services (RDS). The Journal of Academic Librarianship, 49(1), 102646.

Nti, I. K., Quarcoo, J. A., Aning, J., & Fosu, G. K. (2022). A mini-review of machine learning in big data analytics: Applications, challenges, and prospects. Big Data Mining and Analytics, 5(2), 81-97.

O'Kelly, M. K., Jeffryes, J., Hobscheid, M., & Passarelli, R. (2023). Correlation between library instruction and student retention: Methods and implications. College & Research Libraries, 84(1), 85.

Ofe, H., De Reuver, M., Nederstigt, B., & Janssen, M. (2023). Data Analytics Platforms: Value Propositions and Adoption Challenges for Small Hospitality Businesses. Paper presented at the Proceedings of the 56th Hawaii International Conference on System Sciences.

Pastorino, R., De Vito, C., Migliara, G., Glocker, K., Binenbaum, I., Ricciardi, W., & Boccia, S. (2019). Benefits and challenges of Big Data in healthcare: an overview of the European initiatives. European journal of public health, 29(Supplement_3), 23-27.

Paul, M., Maglaras, L., Ferrag, M. A., & AlMomani, I. (2023). Digitization of healthcare sector: A study on privacy and security concerns. ICT Express.

Pimentel, J. L., & Pimentel, J. (2019). Some biases in Likert scaling usage and its correction. International Journal of Science: Basic and Applied Research (IJSBAR), 45(1), 183-191.

PMDC. (2019). Pakistan Medical and Dental Council. Retrieved 22.09.2020 www.pmdc.org.pk

Pramanik, P. K. D., Pal, S., & Mukhopadhyay, M. (2022). Healthcare big data: A comprehensive overview. Research anthology on big data analytics, architectures, and applications, 119-147.

Qi, Q., Xu, Z., & Rani, P. (2023). Big data analytics challenges to implementing the intelligent Industrial Internet of Things (IIoT) systems in sustainable manufacturing operations. Technological Forecasting and Social Change, 190, 122401.

Quadir, B., Chen, N.-S., & Isaias, P. (2022). Analyzing the educational goals, problems and techniques used in educational big data research from 2010 to 2018. Interactive Learning Environments, 30(8), 1539-1555.

Rawson, A., & Brito, M. (2023). A survey of the opportunities and challenges of supervised machine learning in maritime risk analysis. Transport Reviews, 43(1), 108-130.

Rehman, A., Naz, S., & Razzak, I. (2022). Leveraging big data analytics in healthcare enhancement: trends, challenges and opportunities. Multimedia Systems, 28(4), 1339-1371.

Schaeffer, D. M., & Olson, P. C. (2014). Big data options for small and medium enterprises. Review of Business Information Systems (RBIS), 18(1), 41-46.

Shi, Y. (2022). Advances in big data analytics. Adv Big Data Anal.

Singh, R. K., Agrawal, S., Sahu, A., & Kazancoglu, Y. (2023). Strategic issues of big data analytics applications for managing health-care sector: a systematic literature review and future research agenda. The TQM Journal, 35(1), 262-291.

Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of Big Data challenges and analytical methods. Journal of Business Research, 70, 263-286.

Talaoui, Y., Kohtamäki, M., Ranta, M., & Paroutis, S. (2023). Recovering the divide: A review of the big data analytics—strategy relationship. Long Range Planning, 102290.

Ullah, M., & Anwar, M. A. (2013). Developing competencies for medical librarians in Pakistan. Health Information & Libraries Journal, 30(1), 59-71.

University, K. M. (2020, Septembe, 11). Khyber Medical University.

Vaidya, G. M., & Kshirsagar, M. M. (2023). A Solution to Query Processing Challenges Through Smart Query Processor for Big Data Analytics. SN Computer Science, 4(2), 163.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management science, 46(2), 186-204.

Watson, H. J. (2019). Update tutorial: Big Data analytics: Concepts, technology, and applications. Communications of the Association for Information Systems, 44(1), 21.

Weerasinghe, S. (2017). Technology Acceptance Model in the Domains of LIS and Education: A Review of Selected Literature. Library Philosophy & Practice.

White, T. (2012). Hadoop: The definitive guide: " O'Reilly Media, Inc.".

Wu, J., Li, H., Liu, L., & Zheng, H. (2017). Adoption of big data and analytics in mobile healthcare market: An economic perspective. Electronic Commerce Research and Applications, 22, 24-41.

Appendix – I Province wise numbers of Recognized Medical Colleges and Attached Teaching Hospitals.

Province	Public	Private	Attached Teaching Hospitals	Total
Punjab	19	43	94	156
Sindh	11	15	50	76
K.P	23	30	65	118
Baluchistan	01	01	05	07
AJ&K	03	01	08	12