Utilization Of Big Data To Assist Hospital Business Operations During Covid

Abstract

Covid-19, the pandemic imposed enormous unforeseen strain on hospital operations. This paper examines how some hospitals have overcome severe interruptions to their operations while meeting the massive medical demands of Covid patients using big data-driven decisions and efficient IT implementation and administration.

Keywords

Hospital Operations, Big Data, Business Intelligence, Covid-19, Data Analytics

1. Introduction and Context

Each hospital aims to provide high-quality care quickly and efficiently while making patients' stays pleasant. Hospitals can achieve this goal by adopting a service-oriented business model. To function properly, all the business groups need to share information efficiently. This report examines how Big Data Analytics and technology in hospital operations have helped overcome some of the issues posed during Covid-19.

2. Information System Management Issue

2.1. Role Of Information Technology Business Unit In A Hospital

Hospital information systems help plan, manage, and execute healthcare processes while documenting patient and procedural data (D.A.S, 2021). This report’s scope does not allow for a comprehensive review of hospital IT. However, it is essential to grasp the business unit's goals and challenges, especially when dealing with unplanned events and Big Data. Appendix A gives more detailed information on an ideal Hospital Information System.

2.2. Role Of Big Data In Healthcare

With the advent of Big Data and its limitless possibilities, hospitals are moving away from reactive analytics to predictive analytics and event-based planning. This decision-making occurs at all operational levels and has been especially effective in various applications. (Durcevic, S, 2021). (Sabyasachi, 2019).

2.3. Main Challenges In Healthcare During Covid-19

As a result of the COVID-19 virus' high transmissibility and virulence, hospitals have had limited time to prepare for overload. This paper focuses on two organizational problems that hospitals have experienced during this time and how Big Data Analytics has been used:

- The need for real-time information management and distribution to support patient care and health services planning
- Recognize and manage potentially contagious Covid patients to protect staff, patients, and visitors.

The study would not examine Big Data's involvement in the treatment or cure of Covid-19.

3. Discussion and Argument

Parkland Memorial Hospital is a tertiary care hospital located in Dallas, Texas. It is Parkland Health & Hospital System's primary hospital and serves as the public hospital for Dallas County. The two Big Data and Analytics applications discussed in this report were implemented in this location during the Covid-19 pandemic**.**

3.1. Command Center Dashboard Case Study

When Parkland Hospital created the Command Center, they first needed to focus on the metrics necessary to govern their hospital operations, which were patients under investigation and monitoring. They then used SAP Analytics Cloud and SAP Digital Boardroom (SearchSAP,2022) to create an Executive Command Center with a Visualization Dashboard to provide hourly updates on critical metrics like count of Coronavirus cases, the number of available hospital beds, and the status of PPE (personal protective equipment) kits to the health system's workforce, (Kesari,2022) enabling them to make life-saving decisions about staffing, procurement, and operations. They gradually added other indicators as the days passed. (Refer to Appendix B)

3.2. COVID-19 Exposure Reduction Using Machine Learning and Geospatial Analytics Case Study

The biggest challenge for health systems was learning about the virus's community spread and predicting who entering the premises might be COVID-19 positive. Parkland Health & Hospital System and PCCI (a non-profit focused on advanced data science and socioeconomic determinants of health) recognized that the physical proximity and density of infected and uninfected individuals facilitate disease spread within a community. Their address and population density in those locations were used to determine an individual's risk of contracting COVID-19 (exposure risk). Parkland used an "exposure risk" index to reduce exposure to patients

and staff and targeted educational and medical outreach in high-risk zipcodes. (Refer to Appendix C)

Parkland's team utilized the Proximity Index for four major system-wide initiatives, **(**Manjula,2022) including triaging over 100,000 patient visits and proactively assessing needs.

1. High-risk patients with appointments within two days were tested in advance to prevent infection transmission within the hospital.
2. Patients at high risk of exposure who were scheduled for an appointment at Parkland in the coming days were offered telemedicine instead of a physical appointment.
3. Vulnerable patients got extra medical and social care (e.g., virtual visits, assistance with medication refills).
4. The highest at-risk zipcodes got targeted information about COVID-19 prevention, safety, symptom monitoring, testing, and medical care options.

3.3. Discussion - How Parkland Achieved Its Big Data And Analytics Initiatives And Challenges

3.3.1. Developing A Mature Data And Analytics Organizational Strategy

Parkland intended to prioritize and organically grow its data analytics program, so it invested in SAP for Advanced Business Information And Analytics starting in early 2000. They developed the MedAdherence dashboard, allowing doctors to check their patients' medication adherence and a huddle board for service line supervisors to review daily KPIs and make data-driven operational decisions. In addition to governance, the IT team focused on gaining clinical community trust. On top of that, it introduced Parkland's healthcare employees to a new technology.

3.3.2. Technology Partnerships

A data virtualization infrastructure combining Hadoop and, as a backup, the SAP Business Technology Platform (BTP) was examined by Parkland in 2014. Following the pandemic, they employed BTP technology to process data and designed a dashboard interface to display data. SAP Analytics Cloud, a BI platform built on SAP HANA that manages and leverages data from multiple sources, and SAP Digital Boardroom Analytics, a data visualization solution that (SearchSAP,2022) creates customizable dashboards using SAP Analytics Cloud data, helped Parkland hospitals prepare for and manage the COVID-19 pandemic surge.

Parkland used PCCI's cloud-based advanced analytics and machine learning platform, Isthmus **(**Manjula,2022), to construct the Proximity Index model. PCCI's machine learning engineering

team integrated the model to Parkland's electronic health record system with the help of Parkland's information technology team and performed geospatial analysis.

3.3.3. Gap Analysis And User Needs

Parkland's data science and clinical teams arranged regular cross-functional meetings to identify the hospital's pandemic gaps and essential measurement requirements. The team got the users' approval for technology adoption by correctly addressing their everyday needs, informing them about new technology, and teaching them how to use it. In exchange, consumers demanded additional features such as drill-down views, real-time notifications, and predictive analytics.

3.3.4. Data Collection Process

Parkland set up livestreams to watch clinic arrivals, testing locations, and phone centers to gather pertinent data. The team created the Dashboard by combining this data with real-time data from the hospital's Epic electronic medical record system. (SearchSAP,2022)

While several data sources improve data reliability and efficiency for machine learning, these data may come from sources with questionable data governance policies. The data may not be clean, comprehensive, correct, and prepared for several systems. IT managers should engage with providers to prioritize data types, recruit professionals in data governance and integrity, and implement clinical documentation improvement programs that train doctors how to guarantee data is suitable for downstream analytics. Automated data cleaning systems compare, contrast, and correct massive datasets using logic principles. IT administrators must utilize such tools as machine learning techniques grow more sophisticated and precise.

3.3.5. Data Storage, Access, and Visualization

Parkland maintained an agile framework with a consolidated collection of data sources to help define KPIs. Quality controls were easy to deploy with data from several sources stored in one area, allowing distant analytics groups to impact business choices. Stored in Epic Caboodle, the data was transported to SAP HANA and then to the SAP Digital Boardroom interface. The hospital used Intel CPUs to analyze data from over 200 sources. Live broadcasting was possible with SAP HANA and Intel® Xeon® and. Parkland provided crucial data on time to all company leaders.

The increasing volume of healthcare data makes managing on-premises data centers difficult. Although an on-premises server network controls security, access, and uptime, it creates data silos across departments. Cheaper and more reliable cloud storage is gaining popularity, but IT managers must carefully select cloud partners to ensure HIPAA compliance and security. A hybrid

infrastructure may be the most flexible and cost-effective solution, but the IT manager should identify vendors who can help dissimilar systems communicate and share data.

3.3.6. Predictive Analysis And Extension Of Application

The Parkland Data analytics team realized that accurately forecasting future events was crucial along with understanding the existing situation. The researchers constructed a predictive model for capacity planning in SAP Digital Boardroom that outperformed (SearchSAP,2022) Penn Medicine's COVID-19 Hospital Impact Model for Pandemics. The team created their model using mortality, hospitalization, and infection rates, which gave the hospital the visibility and confidence it needed to grow its AI and machine learning capabilities.

Healthcare data is stored for a considerable period of up to six years. Physicians may opt to conduct research utilizing de-identified data that can be reused or reexamined for quality assurance or performance benchmarking. Thus, researchers and data analysts must know when and who developed the data and who utilized it previously, why, how, and when. As a result, it is critical for Healthcare Information Technology teams to assign a Data Steward to oversee metadata development and curation.

Robust metadata and stewardship protocols also assist health teams in querying their data and obtaining the information they require. Before implementing query tools, the IT team must address data silos and interoperability concerns. It may be impossible to create a comprehensive picture of a hospital's or a patient's health if data is stored in multiple siloed systems or formats. Even when data is exchanged, quality and standards may be inadequate. Without a standardized medical coding system such as ICD-10, SMOMED-CT, or LOINC, it is hard to ensure that a query returns the proper data to the user. Numerous hospitals utilize SQL to query enormous datasets and relational databases, but this technique is only effective provided users have confidence in the data's accuracy, completeness, and uniformity.

4. Conclusion

Extensive communication, collaboration, and invention must occur rapidly and concurrently to respond successfully to major shocks in an organization. The following sections describe some aspects discovered during this research that should be considered when developing Big Data integration solutions for healthcare in a very agile setting.

4.1. Avoid Technical Debt

Bad designs are implemented when inaccurate business needs are comprehended, technological infrastructure is inadequate, or a lack of foresight aligns with organizational strategy. This makes

it extremely costly to construct data-driven applications on top of it and will add to the time and expense of implementation. As a result, reducing technical debt is critical.

4.2. Prepare For Iterations.

The Pandemic has demonstrated the importance of predictive analytics and may hasten its adoption in standard care in the future. The first solution developed may not be the final solution chosen by consumers, as most transformational innovations require multiple iterations to show their worth. Change management procedures must be followed to achieve this level of value, and it will demand the IT team's time, effort, and resources.

4.3. Plan And Prepare For Data Change Velocity

Rapid modifications, corrections, and back-end integration must be incorporated into the technology strategy when planning for technological changes. Healthcare data is dynamic, and most elements will require regular changes to stay current. IT managers that do not regularly monitor their data assets may struggle with Big Data's volatility. Thus, to avoid end-user downtime, the IT team must know which datasets require manual updating and which may be automated.

4.4. Maintain The Digital Transformation.

An organization requires an IT management team constantly reviewing modern technologies to create and sustain an environment conducive to digital transformation, the key is for the management team to have a clear vision and strategy for what it wants from Big Data and why.

4.5. Data interoperability

External data exchange is crucial for population health management and value-based treatment. But data flow between enterprises is restricted by bad EHR designs and implementations, making machine learning and data analysis initiatives more complex. New Technologies like FHIR, public APIs, and partnerships like CommonWell and Carequality allow developers to safely share data. Thus, IT managers must ensure that these strategies are used or risk losing the benefits of smooth patient data sharing.

5. Critical Reflections

5.1. Big Data Project Outsourcing

One of the two initiatives discussed was developed entirely in-house, while the other was produced in collaboration with PCCI. Another option was to outsource the project. Management must first assess its current situation's strengths and weaknesses before considering outsourcing. This way, the most critical vulnerabilities would be addressed. A detailed cost analysis compared to the opportunity costs associated with the resources freed up to conduct other duties would show which aspects of the project are the most suitable for outsourcing. A service level agreement (SLA) incorporating all the above conditions must be signed with the outsourcing partner.

Choosing a Data Analytics and Business Intelligence vendor/co-developer with healthcare domain competence is critical for setting solution timeframes. If the hospital wants to grow or adapt to unexpected changes in volume, value, variety, velocity, and veracity, a data analytics provider with the appropriate technological maturity and willingness to expand will be required. Big Data and analytics start with a discovery phase that allows for some path ambiguity. The Vendor should be ready to make necessary adjustments if a feasible and successful solution is created. To assure the quality of outsourced partners and personnel, hospital IT management would need to create a thorough governance system to ensure the quality of outsourced partners.

5.2. Organizational Strategic Planning Post Pandemic in Healthcare

During the COVID-19 outbreak, healthcare organizations ceased strategic planning, and long-term planning was thrown to the back burner. But as we emerge from it, business units should refocus on strategy analysis to prepare for the new normal in healthcare. The pandemic has prompted organizations to prioritize data and analytics in its strategy.

The IT Team should consider the pandemic and the rapid reaction tactics that were employed. Then, decide which components worked, should be eliminated, and should be maintained and updated. Teams should review their records to determine the success of their Data Analytics implementations. Questions that may prompt additional research and data insights, as well as a strategic call, include the following:

- What were the initial roadblocks to Big Data adoption?
- What IT implementation strategies were effective during the pandemic?
- What Business and Big Data strategies were omitted and why?
- Was the security infrastructure sufficiently robust for the Big Data solutions implemented during Covid? If not, what were the glitches, and what caused them?

- Was the security compliant with regulatory requirements? If not, which areas demand additional work?
- What kind of technologies need to be invested and who would be the copartners to co-develop with?
- What possibilities exist for repurposing what has been developed once COVID-19 concludes?

If a healthcare institution desires to reap the benefits of Big Data and analytics, part of the business strategy would be to acquire experienced Data Analytics professionals within the IT team as well. Some critical team members that should be included are:

- A Chief Analytics Officer (CAO) to lead the team to understand various data types in the healthcare industry, dissect problems, and guide team members through the data problem-solving process.
- Data Scientists to leverage technology and data to make it actionable across the organization for optimizing the healthcare experience and outcomes.
- Business Intelligence Managers to assist various stakeholders within an organization in synthesizing data and experiences to facilitate decision-making.

(2498 Words - Section 1 To Section 5)

Bibliography

Kesari, G., 2022. *How Data Analytics Helped This Hospital Win Its Battle Against Covid-19*. [online] Forbes. Available at: <https://www.forbes.com/sites/ganeskesari/2021/07/28/how-data-analytics-turned-a-game-changer-in-parkland-hospitals-battle-against-Covid-19/?sh=1a356dca4692>

D.A.S., 2021. *Information Systems in health care.* HEALTHCARE SERVICE DELIVERY. Available at: https://drdollah.com/hospital-information-system-his/

LeanTaaS, I.collaboration , 2021. *How UCHealth is using data analytics to optimize capacity, streamline Covid-19 response.* Becker's Hospital Review. Available at: https://www.beckershospitalreview.com/hospital-management-administration/how-uchealth-is-using-data-analytics-to-optimize-capacity-streamline-Covid-19-response.html

Durcevic, S., 2021. *18 examples of Big Data in healthcare that can save people.* News, Insights and Advice for Getting your Data in Shape. Available at: https://www.datapine.com/blog/big-data-examples-in-healthcare/

Sabyasachi et al., 2019. *Big Data in Healthcare: Management, analysis, and Future Prospects* - Journal of Big Data. SpringerOpen. Available at: https://journalofbigdata.springeropen.com/articles/10.1186/s40537-019-0217-0

Kent, J., 2020. 3 ways healthcare is using predictive analytics to combat COVID-19. HealthITAnalytics. Available at: https://healthitanalytics.com/news/3-ways-healthcare-is-using-predictive-analytics-to-combat-Covid-19 .

SearchSAP. 2022. *SAP Digital Boardroom helps Parkland Health manage pandemic*. [online] Available at: https://searchsap.techtarget.com/news/252489605/SAP-Digital-Boardroom-helps-Parkland-Health-manage-pandemic

Manjula Julka, D., 2022. *How Parkland Leverages Machine Learning, Geospatial Analytics to Reduce COVID-19 Exposure in Dallas*. [online] Hitconsultant.net. Available at: https://hitconsultant.net/2020/09/21/parkland-pcci-Covid-19-exposure-dallas/

Appendix A:

Fig 1: Main Divisions of HIS (*Healthcare Information System*)

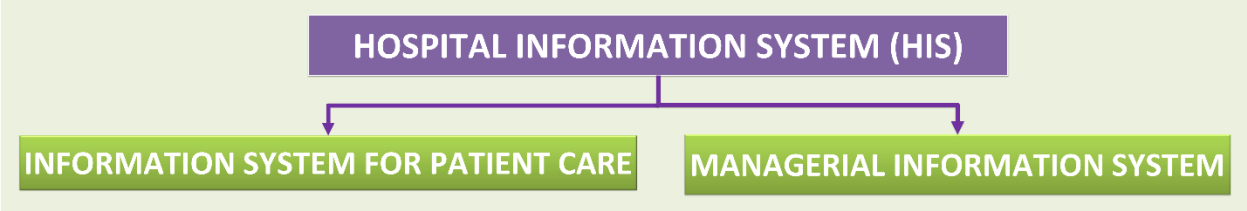


Fig 2: Patient Care Information System

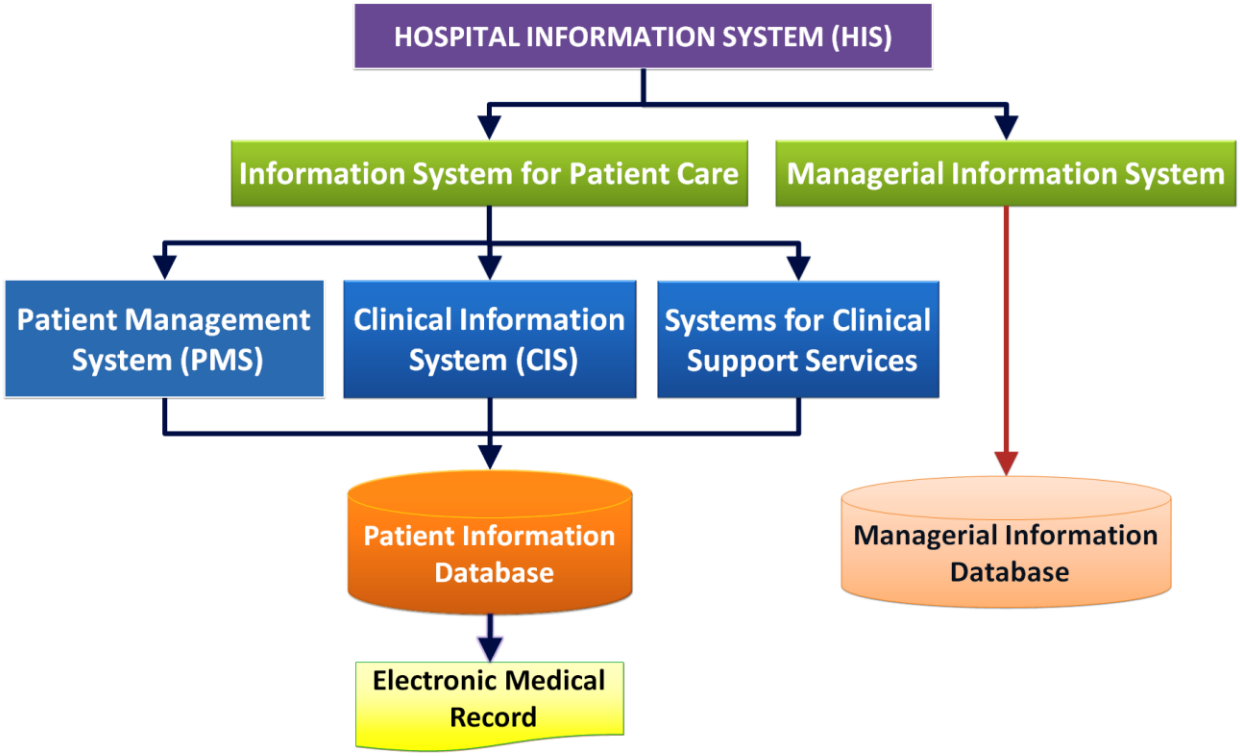


Fig 3: Components of the Clinical Information System

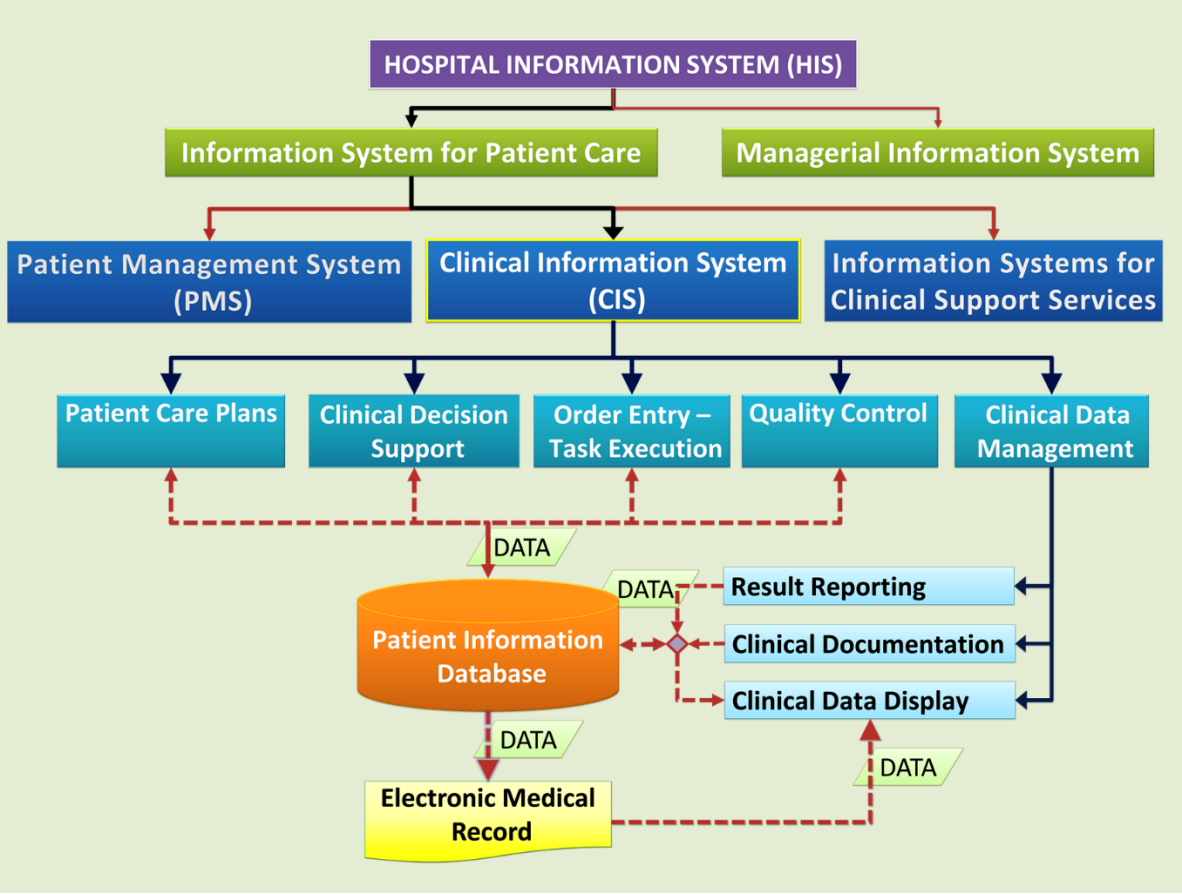


Fig 4: System for Clinical Support Services

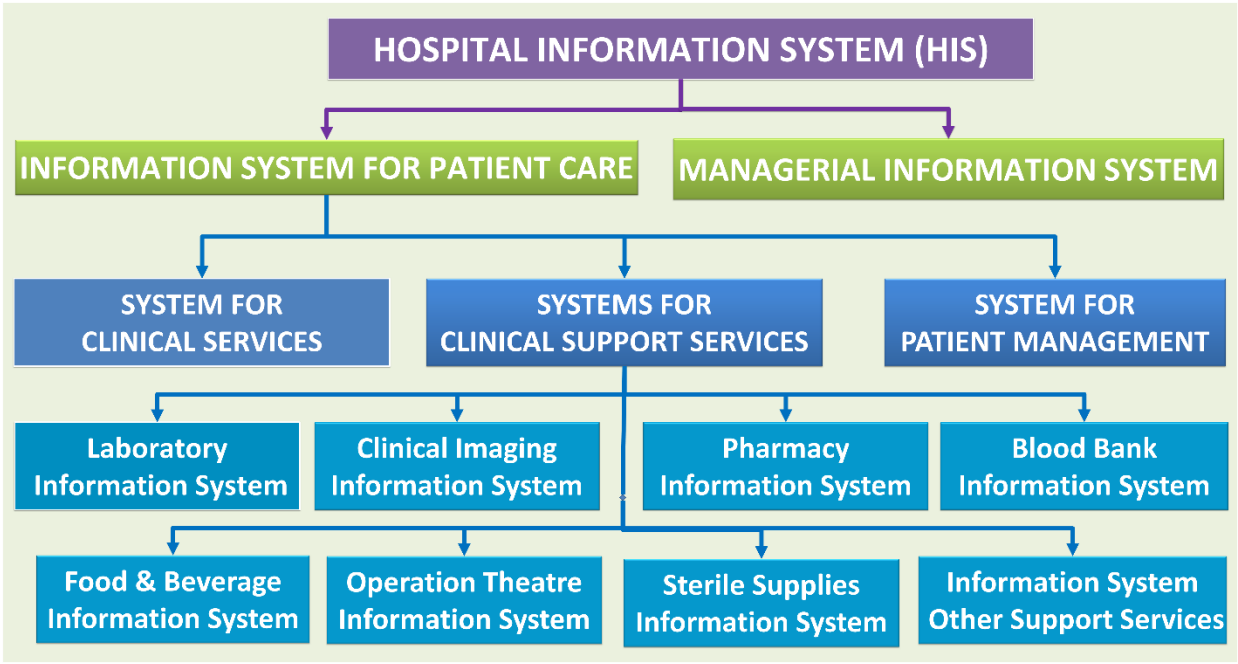
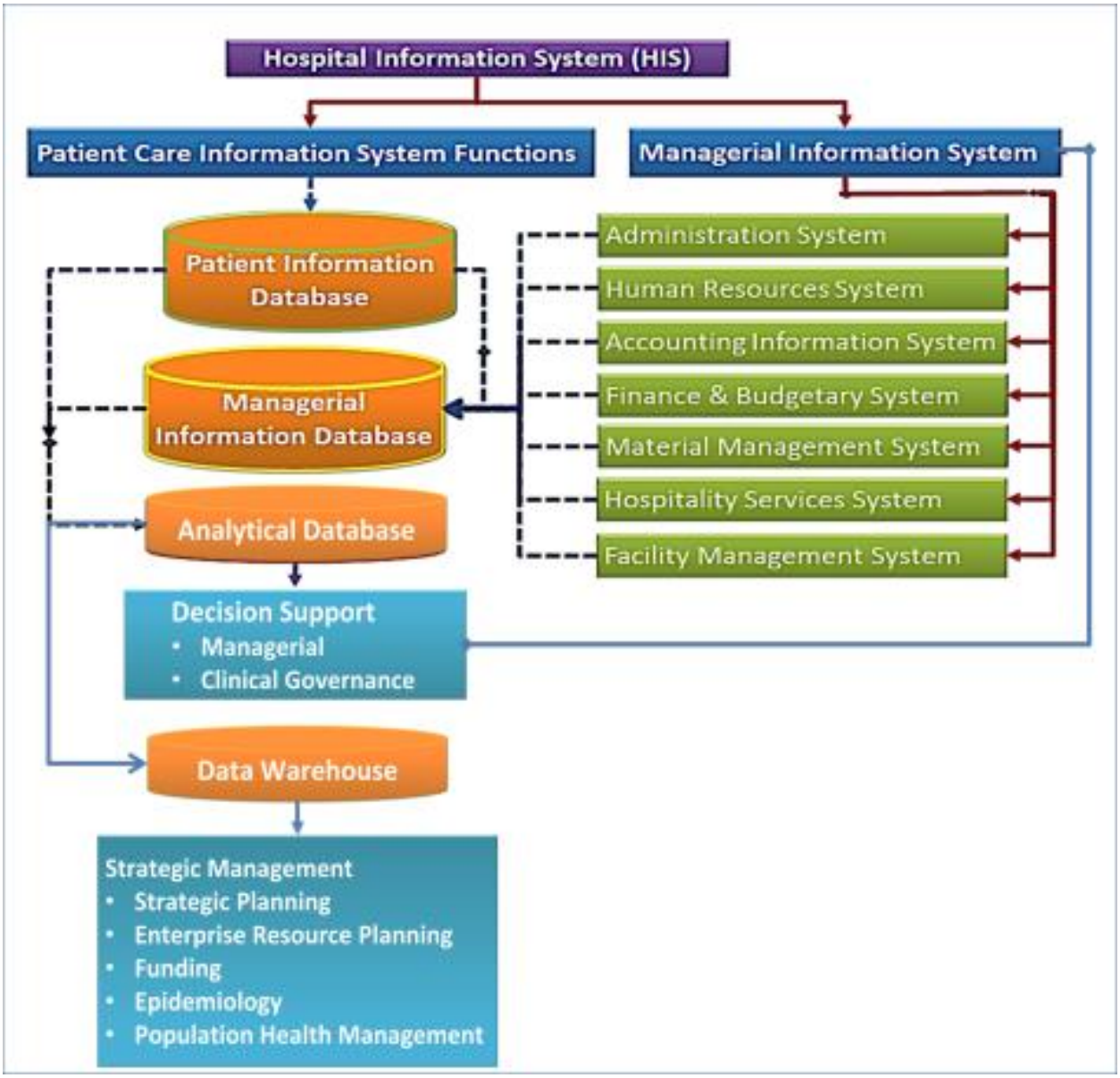
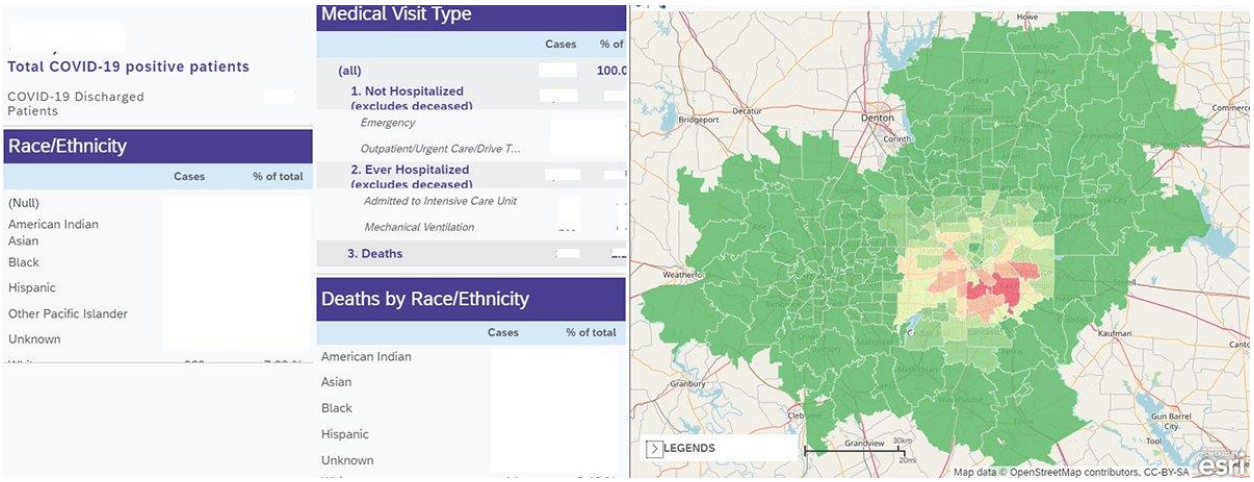


Fig 5: Managerial Information System



Appendix B:

Fig 6: Parkland Health and Hospital System's SAP Digital Boardroom dashboards. (SAP Digital Boardroom helps Parkland Health manage pandemic, 2022)



Appendix C:

Fig 7: Proximity Index Process (Manjula Julka, 2022)