
Hospital Management Strategies for Data Recording during a Public Health Crisis

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Abstract:

During a public health crisis, effective data recording is crucial for hospitals to manage patient care, resource allocation, and infection control efficiently. One primary strategy involves implementing robust data collection systems that allow for real-time tracking of patient information, healthcare resources, and staff availability. Utilizing Electronic Health Records (EHR) systems ensures that all patient interactions are documented accurately and can be accessed swiftly by medical personnel. Hospitals can also establish centralized databases that facilitate communication between departments, allowing for better coordination in response efforts. Training staff on these systems is essential to ensure personnel are adept at inputting and retrieving data, minimizing errors that could arise from high-pressure environments. Another important strategy is leveraging data analytics to interpret the collected information effectively. By employing business intelligence tools, hospitals can analyze trends in patient admissions, outcomes, and resource utilization to make informed decisions. Hospitals should also develop standardized protocols for data collection to ensure consistency across various departments and locations, which is vital during widespread crises such as pandemics. Collaboration with public health authorities and other healthcare institutions can enhance data sharing, leading to a more comprehensive understanding of the crisis's impact. Furthermore, focusing on patient privacy and data security is essential, given the sensitive nature of health information, necessitating the adoption of stringent security measures to prevent breaches.

Keywords: Data Recording, Public Health Crisis, Hospital Management, Electronic Health Records (EHR), Real-time Tracking, Resource Allocation, Data Analytics, Data Analytics, Business Intelligence Tools, Standardized Protocols, Patient Privacy, Data Security. Collaboration.

Introduction:

The significance of effective hospital management strategies has become exceedingly apparent during public health crises, notably highlighted by the global COVID-19 pandemic. The cornerstone of these management strategies revolves around meticulous data recording practices, which serve as a bedrock for operational efficiency, resource

allocation, clinical decision-making, and epidemiological research. This introduction aims to delineate the essential aspects of data recording strategies implemented by hospitals during public health crises, the challenges encountered, and the implications for future healthcare management practices [1].

In situations of public health emergencies, healthcare institutions are challenged to adapt swiftly to unprecedented increases in patient volume and complexity. Fundamental to confronting such challenges is the need for accurate and timely data recording. This aspect not only encompasses patient demographics, clinical presentations, and treatment regimens but also extends to logistical information pertaining to hospital resources, such as bed availability, medication inventories, and staffing levels. Consequently, robust data management systems are indispensable for hospitals aiming to navigate the fluid dynamics of a public health crisis effectively [2].

Historically, hospitals have relied on paper-based documentation, which, although functional in stable conditions, can be woefully inadequate for managing the exponential increase in data during crises. The transition from traditional methods to more sophisticated electronic health records (EHR) systems is a vital strategy for enhancing data accuracy, accessibility, and interoperability among healthcare providers. EHR systems, when effectively implemented, can facilitate real-time data collection and sharing, allowing for rapid decision-making that can ultimately improve patient outcomes. However, the challenges of technology integration—including staff training, cybersecurity concerns, and system interoperability—can complicate the adoption of these necessary systems [3].

Moreover, the role of data recording extends beyond just immediate clinical needs. Public health officials rely on comprehensive data sets to track disease spread, analyze demographics, and implement targeted interventions. Accurate data collection aids not only in managing current crises but also assists in forecasting potential outbreaks. During the COVID-19 pandemic, for instance, hospitals were called upon to furnish data to local, state, and federal health departments to assist in resource distribution, public health policy formulation, and vaccine rollout strategies. Hence, the efficacy of data recording strategies has direct implications for public health outcomes [4].

The integration of advanced technology—such as artificial intelligence, machine learning, and data analytics—into healthcare systems has the potential

to transform data recording processes during public health crises. Machine learning algorithms, for instance, can analyze vast datasets to identify trends, predict future healthcare needs, and optimize resource allocation in real-time. Telehealth services, which saw a remarkable rise during the pandemic, also underscore the necessity for robust data recording practices that encompass remote patient monitoring and virtual consultations [5].

Additionally, the COVID-19 pandemic elucidated disparities in healthcare access and outcomes, spotlighting the importance of demographic data in understanding how different populations are affected by health crises. Recording and analyzing this data is critical for developing equitable healthcare strategies that address the needs of vulnerable and underserved communities. Hospitals, compelled by social responsibility, must strive to implement data collection methodologies that reflect these disparities to enhance future pandemic preparedness [6].

As we look toward the future, the lessons learned from past crises are invaluable in shaping more resilient healthcare systems. The establishment of protocols for standardized data recording, training programs for hospital staff, and the maintenance of adaptable EHR systems could mitigate the risks posed by potential public health emergencies. Moreover, fostering collaborative partnerships among hospitals, public health entities, and technology providers will be essential for creating a cohesive and responsive data ecosystem [7].

Importance of Accurate Data Recording in Public Health Crises:

In the realm of public health, the accurate recording and management of data are paramount, particularly during crises such as pandemics, natural disasters, or widespread disease outbreaks. The significance of data extends beyond mere numbers; it has profound implications for decision-making, resource allocation, public communication, and ultimately, the health outcomes of populations [8].

Health crises, by their very nature, are unpredictable and often evolve rapidly. This unpredictability necessitates a robust framework for data collection and analysis. Accurate data recording serves as the backbone of emergency preparedness plans,

allowing public health officials to identify potential threats, characterize their scope, and respond appropriately. Early detection of anomalies in health data can lead to timely interventions, potentially curtailing the impact of emerging threats [9].

For instance, during the COVID-19 pandemic, countries that implemented real-time data collection systems were able to monitor the virus's spread, track contacts, and allocate resources effectively. Such proactive measures were vital in instituting lockdowns, enforcing travel restrictions, and mobilizing healthcare resources to hotspots. Conversely, countries that struggled with data accuracy experienced delayed responses, leading to overwhelmed health systems and higher morbidity and mortality rates [9].

The formulation of effective public health policies hinges on comprehensive and accurate data. Policymakers rely on data to understand the epidemiology of diseases, evaluate the effectiveness of interventions, and make informed decisions about future health policies. For instance, during the Ebola outbreak, accurate data allowed health officials to understand transmission dynamics, which informed isolation measures, vaccination strategies, and community engagement efforts [9].

Moreover, data-driven policies can also foster public trust in health authorities. Transparency in data reporting enhances accountability and allows the public to understand the rationale behind health measures. Accurate data fosters credibility; when people believe in the data presented by health authorities, they are more likely to comply with recommended guidelines, such as vaccination campaigns and public health advisories [10].

In public health crises, resources such as medical supplies, personnel, and financial support must be allocated judiciously. Accurate data recording plays a critical role in identifying the needs of specific communities and ensuring that resources are distributed equitably. Through detailed data analysis, health authorities can ascertain which areas are most at risk and require immediate assistance, thus optimizing resource deployment [11].

For example, during the H1N1 influenza pandemic in 2009, health departments that relied on accurate surveillance data were better equipped to allocate

vaccines to high-risk populations, including healthcare workers and individuals with pre-existing conditions. This targeted approach not only maximized the impact of the vaccination campaign but also minimized wastage of limited vaccine supplies.

Accurate data recording is equally vital for advancing public health research and fostering innovation. Robust data sets enable researchers to conduct epidemiological studies, identify trends, and discover new facets of diseases. Furthermore, they support the clinical trials necessary for the development of vaccines and therapeutics [12].

During the COVID-19 crisis, researchers worldwide leveraged accurate data to facilitate the rapid development of vaccines. By analyzing data from diverse populations, scientists could ensure that vaccines were effective across different demographics, thus enhancing their safety and efficacy. The timely sharing of data among researchers also accelerated the pace of innovation, culminating in the unprecedented rapid development and distribution of vaccines.

While the importance of data in public health crises is clear, it is essential to emphasize the need for data integrity and ethical data practices. Inaccurate, incomplete, or biased data can lead to misguided health responses, which may exacerbate rather than alleviate a crisis. Data collection and recording processes must adhere to rigorous scientific standards, ensuring that the information gathered is valid, reliable, and applicable [13].

Moreover, ethical considerations are paramount in public health data recording. This includes protecting the privacy and confidentiality of individuals, particularly in sensitive health issues. Transparency in how data is used and the purposes for which it is collected can help build public trust, which is critical in encouraging participation in health data initiatives, such as contact tracing during outbreaks.

Finally, accurate data recording is essential for building community resilience in the face of public health crises. Communities equipped with reliable health information can make informed decisions regarding risk behaviors, vaccination, and preventive measures. Data can empower

communities, enhancing their engagement in public health efforts and fostering a sense of ownership over their health outcomes [14].

Community-based data initiatives, such as health surveys and participatory research, can ensure that the voices of diverse populations are heard and that their unique health needs are recognized. Such approaches not only contribute to more effective public health interventions but also strengthen community bonds and enhance collective action during crises [14].

Technological Innovations in Electronic Health Records (EHR):

The healthcare landscape has undergone a seismic transformation in the last two decades, driven by advances in technology that aim to enhance patient care, streamline administrative processes, and improve clinical outcomes. At the forefront of these innovations is the electronic health record (EHR) system—a digital alternative to traditional paper-based records. As EHRs continue to evolve, various technological innovations are reshaping their functionality, making them indispensable tools for healthcare providers, patients, and researchers [15].

Historically, the concept of electronic health records has its roots in the 1960s, with early attempts focusing on digitizing patient information for hospitals and clinics. However, widespread adoption did not occur until the 1990s and 2000s, driven by government incentives, mandates such as the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, and a general push for improved healthcare quality and efficiency. Today, EHR systems comprise comprehensive many features encompassing patient demographics, medication lists, treatment history, and clinical notes [15].

The transition from paper to electronic records has not only improved data accessibility but has also motivated further technological integrations that promise to revolutionize patient care. The relationship between technological advancements and EHR effectiveness underscores a trend toward more interoperable, patient-centered health information systems.

Interoperability, or the capability of different EHR systems to communicate and share data smoothly, is one of the most vital innovations in contemporary healthcare. By allowing seamless data exchange among various healthcare providers, interoperable EHR systems improve care coordination, reduce redundancy, and enhance patient safety. Technologies such as Fast Healthcare Interoperability Resources (FHIR) provide standardized protocols for sharing health information across different platforms, enabling interoperability and efficient data exchange. The active promotion of interoperability by healthcare authorities has led to collaborative efforts among stakeholders to develop APIs and shared data networks [16].

Artificial Intelligence (AI) and Machine Learning (ML) are increasingly being integrated with EHR systems to enhance clinical decision-making processes. AI algorithms can analyze large datasets efficiently, assisting healthcare providers in identifying patterns that might go unnoticed in conventional approaches. For instance, AI-powered predictive analytics can assess patient risk factors or forecast disease progression based on historical data, ultimately allowing for timely interventions [17].

Additionally, natural language processing (NLP), a branch of AI, assists in extracting unstructured data from clinical narratives, making it more usable for clinical decision support systems (CDSS) that provide alerts or recommendations tailored to individual patients. The implementation of these technologies can help mitigate errors, personalize treatment plans, and improve patient outcomes [17].

The emergence of telemedicine has been a game-changer in healthcare delivery, particularly following the global COVID-19 pandemic. Integration between EHRs and telemedicine platforms allows for a continuous flow of information, enabling providers to document telehealth visits directly within the patient's electronic record. Furthermore, functionality such as appointment scheduling, remote monitoring, and real-time data sharing enhances patient engagement and supports continuity of care [18].

Telemedicine integration also empowers patients by providing them with easy access to their health records, which can enhance their understanding of

conditions and treatment plans. These empowered patients are more likely to participate actively in their health management, leading to improved adherence and better health outcomes [18].

The design and functionality of patient portals have undergone significant advancements, transforming how patients interact with their healthcare providers and manage their health information. Patient portals, often integrated with EHR systems, provide patients with secure access to their health records, lab results, appointment scheduling, and prescription refill requests [18].

Innovations such as mobile health applications enable patients to receive reminders for medication and follow-up appointments, access educational materials tailored to their needs, and track their health metrics, such as blood pressure or glucose levels. These tools enhance patient engagement by fostering a collaborative environment in which patients take an active role in their health management. As patients become more informed, they can better advocate for their interests and participate in shared decision-making processes with their healthcare teams [19].

With the increasing use of EHR systems comes the heightened risk of data breaches and cyberattacks. Consequently, innovative cybersecurity measures have become essential in protecting sensitive health information. Techniques such as end-to-end encryption, multi-factor authentication, and regular security audits have gained traction to safeguard EHR systems.

Additionally, advancements in blockchain technology are being explored for use in healthcare data security. Blockchain's decentralized nature could provide a more tamper-proof ledger of patient records, allowing for secure and transparent data sharing among authorized entities. The integration of advanced security measures not only protects patient data but also builds trust among patients seeking care [19].

Real-Time Data Collection and Reporting Mechanisms:

In the wake of recent global health crises, such as the COVID-19 pandemic, the importance of real-time data collection and reporting mechanisms has

become increasingly apparent. These mechanisms are essential for effective public health response, enabling governments, health organizations, and communities to monitor outbreaks, allocate resources, and implement timely interventions [20].

Real-time data collection refers to the continuous gathering of information that can be analyzed and acted upon immediately. In the context of public health, this data can include infection rates, hospitalizations, vaccination statuses, and demographic information. The significance of real-time data collection during a public health crisis cannot be overstated. It provides the foundation for informed decision-making and allows public health officials to respond swiftly to emerging threats [20].

One of the primary benefits of real-time data is its ability to reveal trends and patterns in disease transmission. For instance, during the COVID-19 pandemic, real-time data allowed health authorities to identify hotspots where the virus was spreading most rapidly. This information facilitated targeted interventions, such as lockdowns or increased testing in specific areas, ultimately helping to contain the spread of the virus.

Moreover, real-time data collection enables the assessment of the effectiveness of public health measures. By analyzing data on infection rates before and after the implementation of specific interventions, health officials can determine which strategies are working and which need adjustment. This iterative process is crucial for optimizing public health responses and ensuring that resources are allocated efficiently [21].

Technologies Involved in Real-time Data Collection

The collection of real-time data during public health crises relies on a variety of technologies. These can range from traditional methods, such as surveys and laboratory reports, to more advanced digital tools that leverage the power of big data and artificial intelligence.

1. **Digital Health Platforms:** Many countries have developed digital health platforms that allow for the rapid reporting of health data. These platforms can aggregate information from hospitals, laboratories,

and public health agencies, providing a comprehensive view of the health landscape. For example, during the COVID-19 pandemic, many countries implemented mobile applications that enabled individuals to report symptoms and test results, which were then integrated into public health databases [21].

2. **Geographic Information Systems (GIS):** GIS technology plays a crucial role in visualizing the spread of diseases. By mapping data points related to infection rates, healthcare resources, and population density, public health officials can identify trends and make informed decisions about resource allocation. For instance, GIS was instrumental in tracking the spread of COVID-19, allowing for the visualization of case clusters and the identification of areas in need of intervention.
3. **Wearable Technology and IoT Devices:** The rise of wearable technology and Internet of Things (IoT) devices has further enhanced real-time data collection. Devices such as fitness trackers and smartwatches can monitor health metrics, such as heart rate and activity levels, and share this data with health authorities. During a public health crisis, this information can provide valuable insights into population health trends and help identify potential outbreaks [21].
4. **Artificial Intelligence and Machine Learning:** AI and machine learning algorithms can analyze vast amounts of data quickly, identifying patterns that may not be immediately apparent to human analysts. These technologies can be used to predict the trajectory of disease outbreaks, assess the impact of interventions, and optimize resource allocation. For example, AI models were employed to forecast COVID-19 case numbers based on various factors, including mobility data and public health measures [21].

Challenges in Real-time Data Collection

Despite the advancements in technology, several challenges persist in the realm of real-time data collection and reporting during public health crises. These challenges can hinder the effectiveness of public health responses and must be addressed to improve future efforts.

1. **Data Privacy and Security:** The collection of real-time health data raises significant concerns regarding privacy and security. Individuals may be hesitant to share personal health information due to fears of surveillance or misuse of data. Public health authorities must strike a delicate balance between collecting necessary data and protecting individuals' privacy rights. Implementing robust data protection measures and transparent data-sharing policies is essential to build trust within communities [22].
2. **Data Standardization and Integration:** Different health agencies and organizations may use varying data collection methods and standards, leading to inconsistencies in the data reported. This lack of standardization can complicate the integration of data from multiple sources, making it challenging to obtain a comprehensive view of the public health landscape. Establishing standardized protocols for data collection and reporting is crucial for ensuring the reliability and comparability of data [23].
3. **Real-time Data Interpretation:** The sheer volume of data collected in real-time can overwhelm public health officials, making it difficult to interpret and act upon the information quickly. Effective data visualization tools and training for public health professionals are necessary to ensure that data is analyzed and communicated effectively.
4. **Equity in Data Collection:** Disparities in access to technology and healthcare can result in unequal data collection. Vulnerable populations may be underrepresented in data sets, leading to gaps in understanding the impact of public health crises on different communities.

Ensuring equitable access to data collection tools and actively engaging diverse communities in the reporting process is essential for comprehensive public health responses [24].

Best Practices for Implementation

To maximize the effectiveness of real-time data collection and reporting mechanisms during public health crises, several best practices should be considered.

1. **Collaboration and Coordination:** Effective collaboration among various stakeholders, including government agencies, healthcare providers, and technology companies, is essential for successful data collection and reporting. Establishing clear communication channels and protocols for data sharing can enhance the speed and accuracy of information dissemination [25].
2. **Public Engagement and Education:** Engaging the public in the data collection process is crucial for building trust and encouraging participation. Public health authorities should educate communities about the importance of data sharing and how it contributes to effective public health responses. Transparent communication about data usage and privacy protections can further enhance public willingness to participate.
3. **Investing in Technology and Infrastructure:** Governments and health organizations should invest in the necessary technology and infrastructure to support real-time data collection. This includes developing user-friendly digital platforms, training personnel in data analytics, and ensuring that healthcare facilities are equipped to report data promptly [26].
4. **Continuous Evaluation and Adaptation:** Real-time data collection mechanisms should be subject to continuous evaluation to identify areas for improvement. Public health authorities should be willing to

adapt their strategies based on emerging data and feedback from stakeholders. This iterative approach can enhance the effectiveness of public health responses over time [26].

Staff Training and Capacity Building for Data Management:

In an era characterized by swift technological advancements and the rapid evolution of global health challenges, the capacity to manage data effectively during public health crises has never been more critical. The COVID-19 pandemic, for instance, demonstrated the profound impact of data on decision-making processes, public policy, and community health outcomes. As health organizations, governmental bodies, and international agencies grapple with the complexities posed by such crises, it is evident that training staff to manage data efficiently is an essential component of a robust public health response [27].

Data management encompasses the systematic collection, storage, analysis, and dissemination of health-related information. In a public health crisis, the ability to manage data accurately can significantly influence the trajectory of the response effort. Decisions regarding resource allocation, vaccination strategies, public health messaging, and community outreach are often grounded in data insights. Therefore, effective data management can lead to timely interventions that save lives, mitigate the crisis's impact, and facilitate recovery [27].

A historical perspective underscores this need; the Ebola outbreak in West Africa (2014-2016) revealed gaps in data collection and sharing, hindering a swift response. Conversely, countries with established data management protocols, such as South Korea during the COVID-19 pandemic, were able to implement effective tracking and tracing measures that curtailed transmission rates. These scenarios highlight that well-trained staff capable of navigating data management systems are crucial for effective public health responses [28].

Components of Effective Capacity Building

To operationalize effective data management during health crises, public health organizations must focus

on several key components in their training programs.

1. **Data Literacy and Competency Development**

Developing data literacy among staff is fundamental. This competency includes understanding the sources, types, and ethics of health data, as well as the ability to analyze and interpret the data. Training should cover various data forms, including quantitative data derived from surveys and healthcare metrics, and qualitative data sourced from patient narratives and public feedback. Workshops and online courses can provide a structured approach to building these skills [29].

2. **Technical Training in Data Management Tools**

The modern landscape of public health relies heavily on software and digital tools for data management. Staff should be trained in using electronic health record (EHR) systems, data visualization tools like Tableau, and analytical software such as R or Python for statistical analysis. Hands-on training sessions and simulations can prepare staff to proficiently use these tools, ensuring they can gather and process data efficiently during crises [29].

3. **Integrated Communication Strategies**

Effective data management is not solely about collecting and analyzing data; it also involves communicating findings clearly to stakeholders. Training programs should include modules on data storytelling, which involves translating complex data insights into understandable and actionable information for non-technical audiences, including policymakers and the public [30].

4. **Collaboration and Team Dynamics**

Public health crises often require inter- and intra-agency collaboration. Staff should be trained to work within multidisciplinary teams, enhancing data-sharing practices and fostering collective problem-solving. Exercises that simulate crisis scenarios can

improve coordination and communication strategies among diverse teams.

5. **Ethical Data Management Practices**

Training must underscore the principles of ethical data management, particularly concerning privacy and informed consent. As public health initiatives increasingly rely on personal health data for decision-making, ensuring employees understand the ethical implications of data collection and use is vital for maintaining public trust [30].

Strategies to Foster an Environment Prioritizing Data Management

To cultivate a culture where data management is prioritized, organizations can adopt several strategic approaches:

1. **Continuous Professional Development**

Data management training should not be a one-time event. Continuous professional development opportunities, including refresher courses, updated training to incorporate new technologies, and access to learning resources, can help ensure staff remain adept at managing data in a rapidly changing landscape [31].

2. **Building a Data-Driven Culture**

Organizations must promote a culture that values data-driven decision-making. Leaders can reinforce this culture by sharing success stories where data management has positively impacted public health outcomes, thus motivating staff to engage with data as a critical component of their work [31].

3. **Investment in Infrastructure**

Equipping staff with the necessary tools and infrastructure is equally important. Organizations should invest in robust data management systems that allow for the seamless integration of information from various sources, providing staff with access to real-time data for informed decision-making.

4. **Engaging with External Expertise**

Partnering with academic institutions and

organizations specializing in data science can provide additional training resources and expertise. Collaborations can pave the way for knowledge exchange, helping public health organizations innovate their data strategies and management practices.

5. **Feedback Mechanisms**
Establishing feedback mechanisms allows staff to share their experiences and challenges in data management. By creating avenues for dialogue, organizations can identify weaknesses in their training programs and implement changes to address staff needs effectively [31].

Data Analytics: Transforming Information into Actionable Insights:

In an age characterized by rapid technological advancement and an overwhelming influx of information, the importance of data analytics has surged to unprecedented levels. Data analytics, the systematic computational analysis of data, has evolved into a crucial discipline that empowers organizations to make informed decisions, optimize performance, and forecast future trends [32].

Understanding Data Analytics

At its core, data analytics encompasses a broad spectrum of techniques designed to extract meaningful information from raw data. It involves a series of procedures, including data collection, cleaning, processing, and interpretation, aimed at drawing actionable insights. Data analytics can be segmented into four primary types: descriptive, diagnostic, predictive, and prescriptive analytics [32].

1. **Descriptive Analytics:** This type involves summarizing past data to understand what has happened in a business. It includes processes such as reporting and visualization techniques, enabling

organizations to gain insights from their historical performance and identify trends.

2. **Diagnostic Analytics:** This aspect focuses on why certain outcomes occurred. By examining historical data, organizations can identify factors and relationships that contributed to specific events, enhancing their understanding of business dynamics [32].
3. **Predictive Analytics:** Utilizing statistical models and machine learning techniques, predictive analytics forecasts future outcomes based on historical data. This approach is pivotal in various sectors, allowing businesses to anticipate market trends, consumer behavior, and potential challenges.
4. **Prescriptive Analytics:** This type recommends actions to achieve desired outcomes. By analyzing various scenarios and potential solutions, prescriptive analytics aids decision-makers in choosing the most effective course of action [32].

Applications of Data Analytics

Data analytics finds applications across numerous sectors, fundamentally altering how organizations operate.

- **Healthcare:** In this field, data analytics plays a crucial role in patient care and operational efficiency. By analyzing patient data, healthcare providers can identify disease patterns, predict outbreaks, and improve treatment protocols. Predictive analytics further facilitates personalized medicine, tailoring treatment plans based on individual patient data [33].
- **Finance:** Financial institutions leverage data analytics to assess risks, detect fraud, and enhance customer service. Risk assessment models, driven by historical data, enable banks to allocate resources effectively and mitigate potential losses. Additionally, customer segmentation and behavior modeling help institutions tailor services to individual preferences.

- **Retail:** Data analytics empowers retailers to refine their marketing strategies and optimize inventory management. By analyzing consumer data and purchasing patterns, retailers can personalize promotions, manage stock levels, and enhance the overall customer experience [33].
- **Manufacturing:** In manufacturing, data analytics enhances operational efficiency and product quality. Predictive maintenance, driven by real-time data analysis, allows manufacturers to anticipate equipment failures and minimize downtime. Moreover, supply chain analytics improves logistics and resource allocation, ensuring timely delivery and cost reduction [34].
- **Sports:** The sports industry has increasingly adopted data analytics for performance evaluation and team management. Athletes and coaches utilize data to analyze performance metrics, optimize training regimens, and develop game strategies. Furthermore, sports organizations apply fan engagement analytics to personalize marketing efforts and improve spectator experiences [34].

The Transformative Impact of Data Analytics

The influence of data analytics on decision-making processes is profound. One of its key contributions is the shift from intuition-based decision-making to a data-driven approach. Organizations can now harness vast amounts of data to support their strategies and initiatives. As a result, decision-makers can minimize biases and enhance the accuracy of their judgments [35].

Moreover, data analytics fosters a culture of continuous improvement. By consistently analyzing performance data and identifying gaps, organizations can implement targeted interventions and measure their effectiveness. This feedback loop enables businesses to adapt quickly to changing market conditions and consumer preferences, establishing a competitive edge [35].

Collaboration is another area significantly impacted by analytics. Cross-departmental data sharing promotes a holistic understanding of organizational performance. When teams communicate openly and leverage shared data insights, they can work synergistically to achieve common goals, driving innovation and improving overall productivity.

Despite its many benefits, data analytics is not without challenges. One of the primary obstacles is data quality. Poor quality data—whether due to inaccuracies, incompleteness, or inconsistency—can significantly skew analysis results, leading to misguided decisions. Organizations must invest in robust data governance practices to ensure that the data they rely on is accurate and reliable [36].

Another challenge is the complexity of data integration. Many organizations generate data across various platforms and tools, making it difficult to consolidate and analyze effectively. A comprehensive data strategy that includes adopting interoperable systems and fostering a culture of collaboration is crucial to overcoming these hurdles.

Additionally, there is a growing concern around data privacy and ethical considerations in data analytics practices. As organizations increasingly collect and analyze consumer data, they must navigate the complex regulatory landscape to ensure compliance and maintain consumer trust. Transparency and ethical data usage are paramount to safeguarding consumer relationships in an era of heightened privacy awareness [36].

Looking ahead, several emerging trends are poised to shape the future of data analytics. First, the integration of artificial intelligence (AI) and machine learning is expected to accelerate analytics capabilities. AI-driven algorithms can process vast datasets more efficiently, uncovering patterns that may not be readily apparent to human analysts. As these technologies evolve, they will likely enhance predictive and prescriptive analytics, enabling organizations to make more informed decisions [37].

The rise of big data is another trend transforming the analytics landscape. With the proliferation of IoT devices and social media, organizations are inundated with massive volumes of data. Managing and extracting insights from big data will require

advanced analytical techniques and infrastructure, paving the way for more sophisticated analytics tools and platforms [37].

Moreover, data visualization tools are becoming increasingly crucial for effective communication of insights. As data becomes more complex, the ability to present findings visually will be essential in facilitating understanding and encouraging action amongst stakeholders at all levels of an organization.

Finally, a greater emphasis on data literacy is becoming apparent. To fully leverage data analytics, organizations must cultivate a workforce that understands how to interpret and utilize data effectively. Upskilling employees in data literacy will empower them to make informed decisions and contribute to a data-driven culture [38].

Collaboration and Data Sharing with Public Health Authorities:

In an evolving landscape of global public health, the significance of collaboration and data sharing among various stakeholders has only intensified. The complexities of health crises, emerging infectious diseases, and chronic health issues require comprehensive strategies that synergize the expertise, resources, and data from diverse entities [39].

Importance of Collaboration

Public health is a multidimensional field that encompasses various sectors, including education, industry, government, and healthcare systems. Effective collaboration among these sectors is critical for several reasons:

1. **Holistic Approach to Health:** Public health issues are seldom isolated problems. They often intersect with socioeconomic factors, environmental conditions, behavioral aspects, and health care access. Collaborative efforts enable a holistic approach, addressing multifaceted determinants of health rather than viewing issues in silos.

2. **Enhancement of Surveillance Systems:** Collaboration enhances disease surveillance, allowing for the sharing of real-time data, which is essential for timely public health responses. For instance, the COVID-19 pandemic highlighted the need for collaborative networks to effectively identify, monitor, and manage outbreaks [39].

3. **Resource Optimization:** Various stakeholders often have different strengths. By collaborating, public health authorities can optimize resource allocation and avoid duplication of efforts. This is particularly important for funding, as many public health initiatives rely on grants and donations that are limited in scope [40].

4. **Strategic Public Health Advocacy:** Partnerships with community organizations can bolster public health advocacy efforts. These organizations often understand the particular needs and challenges of the communities they serve, which can guide effective health messaging and interventions.

5. **Research and Innovation:** Government agencies, academic institutions, and private sector organizations can collaborate to foster innovation in public health research. Joint research initiatives can lead to breakthroughs in disease prevention, intervention strategies, and health promotion, providing valuable insights that can be applied to public health policies [40].

Data Sharing: A Cornerstone for Effective Collaboration

Data serves as the backbone of public health decision-making. Sharing data among various stakeholders is crucial for informed policy development, program implementation, and evaluation. The benefits of data sharing include:

1. **Informed Decision-Making:** Real-time data analytics enable public health authorities to make more informed decisions. Access to a broader dataset

allows for the identification of trends, patterns, and outliers, which can inform intervention strategies and policy adjustments [41].

2. **Comparative Analysis:** Sharing data enables comparative analysis between different regions or populations, fostering better understanding of local and global health trends. For instance, analyzing vaccination rates across various demographics can highlight disparities and inform targeted interventions [41].
3. **Interdisciplinary Collaboration:** Data sharing fosters interdisciplinary collaboration by bringing together experts from various fields, including epidemiology, biostatistics, and informatics. This interdisciplinary approach enriches data interpretation and strengthens overall public health practice.
4. **Enhanced Public Health Communication:** Data sharing promotes transparency and helps build trust among stakeholders and the communities they serve. By making data accessible, public health authorities can engage the public in health discussions, thereby enhancing communication and compliance with health initiatives [42].

Challenges to Collaboration and Data Sharing

Despite the myriad benefits, several challenges impede collaboration and data sharing among public health authorities and other stakeholders:

1. **Privacy Concerns:** The sensitivity of health data poses significant privacy concerns. Regulations such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States place limitations on data sharing to protect individual privacy. Balancing public health needs with individual privacy rights is a complex and ongoing challenge [43].
2. **Data Standardization:** The lack of standardized data formats across different organizations can hinder effective data sharing. Variations in data definitions,

collection methodologies, and reporting practices can lead to inconsistencies, complicating data integration and analysis.

3. **Resource Constraints:** Many public health authorities operate with limited resources, both in terms of funding and manpower. Establishing and maintaining collaborative networks requires investment in infrastructure, tools, and personnel, which may not always be feasible [43].
4. **Inter-organizational Reluctance:** Some organizations may be reluctant to share data due to concerns over losing competitive advantages or issues related to trust. Building robust collaborative relationships takes time and requires ongoing commitment from all stakeholders.
5. **Technological Barriers:** The rapid evolution of data technologies can create a gap between public health authorities and the necessary tools for effective data sharing. Many agencies must continually upgrade their technology and skills to keep pace with advancements in data analytics and sharing platforms [44].

Pathways to Effective Collaboration and Data Sharing

To overcome these challenges, several strategic pathways can enhance collaboration and data sharing among public health authorities and stakeholders:

1. **Establishing Clear Policies and Guidelines:** Developing clear data sharing policies that prioritize privacy while promoting transparency can help mitigate concerns. Guidelines should clearly outline the purposes of data sharing, consent mechanisms, and data security measures [45].
2. **Investing in Technology:** Public health agencies should invest in interoperable data systems that facilitate easy sharing of information across platforms. The adoption of cloud-based solutions and data visualization tools can enhance

accessibility and usability of public health data.

3. **Training and Capacity Building:** Training programs for public health professionals on data sharing best practices, privacy laws, and technological tools can empower agencies to engage in effective data collaboration. Workshops, seminars, and online courses can facilitate skills development [46].
4. **Building Trust Through Engagement:** Collaboration can be fostered by establishing regular communication channels among stakeholders. Engaging community members and organizations in the data-sharing process can help build trust and promote participatory approaches to public health.
5. **Creating Collaborative Networks:** Developing formal networks that bring together public health authorities, academic institutions, community organizations, and private sector stakeholders can enhance collaboration. These networks can focus on specific health issues, shared resources, and joint research initiatives [47].

Ensuring Data Privacy and Security in Crisis Situations:

In an increasingly interconnected world, the importance of data privacy and security becomes particularly pronounced during crisis situations. Natural disasters, public health emergencies, geopolitical conflicts, and cyberattacks not only threaten physical and social infrastructure but also jeopardize sensitive data. The implications of poor data management during these critical times can be both widespread and devastating, affecting individuals, organizations, and entire nations. Thus, ensuring data privacy and security in crisis situations is not merely a technical concern but a matter of ethical responsibility, legal obligation, and societal trust [48].

Data privacy refers to the proper handling, processing, storage, and usage of personal and sensitive information. It encompasses various legal

frameworks and policies that govern how data is collected, shared, and managed, emphasizing the rights of individuals regarding their personal information. Data security, on the other hand, pertains to the protection of data from unauthorized access, breaches, or corruption. It involves various technologies and practices designed to safeguard data integrity and confidentiality [49].

The distinction between data privacy and security is crucial; while security focuses on protecting data from external threats, privacy centers around the proper management of data and ensuring individuals' rights. In crisis situations, the balance between these two aspects can become tenuous, highlighting the need for comprehensive strategies that address both [49].

During a crisis, the urgency of response efforts can overshadow the meticulousness required for data management. Situations such as pandemics, where personal health data is paramount, or natural disasters, which often lead to the collection of large volumes of personal information for disaster relief, can contribute to increased risks. Weaknesses in data systems become more apparent, and the likelihood of data breaches or misuse increases considerably [50].

Cybercriminals often exploit periods of crisis. They may launch phishing campaigns or ransomware attacks under the guise of official communications related to the crisis, knowing that individuals and organizations are particularly vulnerable during such times. In essence, the combination of fear, urgency, and uncertainty promotes a fertile ground for malicious actors.

In response to these increased risks, governments and organizations must develop robust policies and legislative frameworks that prioritize data privacy even in challenging times. For instance, data protection laws such as the General Data Protection Regulation (GDPR) in Europe provide a structure for ensuring privacy rights. During emergencies, it is critical for policymakers to assess how existing laws apply and whether adjustments are needed to maintain privacy standards without compromising the efficacy of crisis response [50].

Policies must not only delineate personal data handling but also include protocols for data sharing

among agencies and organizations involved in the crisis response. A coordinated approach can help ensure that data is shared securely, minimizing risks while allowing for rapid information flow crucial for response efforts.

Best Practices for Data Management during Crises

Organizations must adopt best practices to ensure data privacy and security in crisis situations. These include:

1. **Data Minimization:** Organizations should only collect data that is necessary for specific crisis-related purposes. Focusing on minimal data collection reduces the risk of exposure [51].
2. **Robust Encryption and Access Controls:** Strong encryption should be applied to protect data at rest and in transit. Implementing strict access controls ensures that only authorized personnel can access sensitive information.
3. **Emergency Protocols and Training:** Organizations must develop and regularly update emergency protocols that account for data privacy and security. Training employees on these protocols ensures readiness during a crisis [52].
4. **Incident Response Plans:** Establishing a structured incident response plan is critical. This plan should delineate steps for containing breaches, notifying affected individuals, and communicating with stakeholders while restoring operations.
5. **Engagement with Legal Experts:** Consulting with legal professionals can help ensure compliance with data privacy laws and regulations that may apply during a crisis. Legal guidance can also aid in developing contingency plans that respect both privacy and security.
6. **Public Transparency:** Clear communication with stakeholders about data handling practices during a crisis builds trust. Organizations should be transparent about how data is collected,

processed, and protected, maintaining open channels for feedback and questions [53].

The Ethical Imperative

The ethical dimension of data privacy and security cannot be overlooked. When individuals provide their information, especially in times of crisis, they do so with an implicit trust that their data will be used responsibly. The betrayal of this trust can have long-lasting repercussions, not only for individuals but for the organizations involved and society at large [54].

By implementing stringent data practices and placing a premium on ethical considerations, organizations can foster a culture of accountability and respect for privacy. This approach not only mitigates risks but also enhances public confidence that organizations are committed to protecting individuals' information [55].

Conclusion:

In conclusion, effective hospital management strategies for data recording during a public health crisis are essential for enhancing patient care, optimizing resource utilization, and facilitating coordinated responses to health emergencies. The integration of advanced technological solutions, such as electronic health records and real-time data collection systems, enables hospitals to capture and analyze vital information efficiently. Training staff in these systems and fostering a culture of data accuracy is crucial to ensure reliable data capture.

Moreover, employing data analytics allows healthcare institutions to derive meaningful insights from collected data, guiding informed decision-making in rapidly evolving situations. Collaboration with public health authorities and adherence to strict data security protocols further strengthen the integrity of the data management process. Ultimately, a proactive approach to data recording and management not only supports hospital operations during a crisis but also lays the groundwork for improved preparedness in future public health emergencies. By prioritizing these strategies, hospitals can enhance their resilience and ability to navigate complex health challenges effectively.

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