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ORIGINAL RESEARCH

Development and Implementation of a Pediatric Clinical Teaching Case Library Based on Massive Real-Time Data

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Background: With the development of information technology, establishing a clinical teaching case library based on vast real-time data resources has become a new educational approach. Nevertheless, a robust theoretical underpinning for harnessing real-time data to enhance clinical education remains elusive. The current body of research frequently falls short of a coherent theoretical structure, and has yet to delve deeply into the intrinsic worth and obstacles that real-time data presents in the educational sphere.

Objective: To construct a real-time data resource set for pediatric clinical cases.

Methods: This study was conducted within the framework of a university-level medical data center where advanced data de-identification protocols and encryption technologies were employed. The inclusion criteria for cases were determined based on their distinctive clinical characteristics and educational relevance aligning with established curriculum standards. These cases were then incorporated into the case library. To ensure ongoing enrichment and relevance of the pediatric clinical teaching case library, a two-phase evaluation system focused on aspects of *storage-use* and *quality-availability* was implemented.

Results: This study successfully established a pediatric clinical teaching case library, supported by substantial real-time data. This database has been seamlessly incorporated into various facets of pediatric education, including classroom instruction in *Pediatrics*, serving as a resource for educational material and facilitating in practical teaching scenarios.

Conclusion: This case library provides an authentic and dynamic data foundation for clinical teaching by leveraging a vast repository of real-time clinical data. It not only facilitates access to high-quality educational resources but also promotes the exploration and adoption of interdisciplinary teaching methodologies. Future research should clarify the theoretical foundation for the application of real-time data, fill existing theoretical gaps, and explore its applicability in various educational environments.

Keywords: case library, clinical teaching, pediatrics, real-time data

Background

As information technology undergoes rapid evolution the education sector is experiencing significant innovations and transformations.[1] Traditional classroom teaching methods in pediatric education are proving increasingly insufficient prompting the demand for more innovative teaching tools and approaches.[2] Although medical education pedagogy has relied on theoretical and clinical instruction since the reforms following the Flexner Report in the early 19th century, there is now a shift towards data-driven and diverse teaching methods that incorporate big data technology. In this context, the convergence of artificial intelligence and big data technology with massive real-time medical data[3] has given rise to clinical teaching case libraries as a novel, information-driven, educational paradigm.

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A clinical teaching case library, harnessing massive real-time data, systematically collects, organizes, categorizes, authentic clinical cases, enhancing them with expert interpretations. Educators and administrators can customize the data resources to align with teaching content, integrating text and images to create a comprehensive case library that meets specific educational needs. By presenting typical cases using real-time data resources this case library enhances its educational value and applicability, more effectively addressing the requirements of clinical medical education. Additionally, it serves as a crucial resource for future technological and scientific advancements in medicine. Consequently, the development of a clinical teaching case library grounded in massive real-time data has emerged as a focal point in medical education research.

Compared to traditional static case libraries,[4] a teaching case library based on real-time data offers numerous advantages. Firstly, the integration of real-time data ensures that the teaching cases closely replicate actual clinical situations, thereby enhancing their practicality and aiding students in better understanding theoretical knowledge and developing practical skills. Secondly, continuous updates with real-time data enable the library to provide detailed records of patient visits, disease progression, treatment responses, strategy adjustments, and outcomes. This creates a more robust foundation for case analysis, discussion, and evaluation, assisting students and doctors in comprehending and addressing clinical challenges and enhancing their problem-solving abilities.

Constructing a clinical teaching case library with extensive real-time data is not merely a significant research area in medical education but also a pivotal driver of its evolution. It elevates teaching quality, promotes pedagogical innovation, enhances student engagement, and nurtures data analysis skills. In pediatric education, where variable conditions, complex etiologies, and treatment compliance challenges abound, there is a heightened demand for high-quality, comprehensive clinical teaching cases. The development of a case library grounded in massive real-time data effectively closes the divide between teaching and clinical practice, enhancing student readiness for real-world medical challenges.

Methods

Related Techniques and Methods of Constructing Pediatric Clinical Teaching Case Base Based on Massive Real-Time Data

Based on big data and other technologies, the four medical institutions affiliated to the army medical university in Chongqing were collected, aggregated and managed to build a solid data base and form a standardized and high-quality medical big data resource pool, thus providing the data foundation and technical support for the pediatric clinical teaching case base.

System Architecture

Based on Hadoop, Hbase, TiDB, Kafka, Spark and other big data-related technologies and frameworks, it provides a stable and efficient data platform for data acquisition, data fusion, data calculation, data mining, data analysis, and data governance, supporting the stable operation of the teaching case base.

Data Mirroring

Integrate OGG, CDC, publish and subscribe, Mirror and other methods to achieve incremental extraction, full table collection and other data collection methods, synchronize the main business database of 4 medical institutions to the front machine in real time, compatible with a variety of databases, such as: ORACLE, Cache, SQLServer, MySQL, SYBASE, and DB2 ensure real-time, stability, and accuracy of data mirroring, and ensure complete data consistency.

Data Collection

Collect the main business data of 4 medical institutions, and support various data collection services including offline, online, real-time and non-real-time. Realize full and incremental parallel access to oracle, MySQL, SQLserver, Cache and other common databases, US7ASCII, ZHS16GBK and other encoding conversion processing between databases, xls, csv, tsv, xml file to obtain data, FTP, SFTP, SSH to obtain data, WebServices or RSS to get data and so on.

Data Management

Based on health information data element value domain code (including electronic medical record), electronic medical record basic data set, electronic medical record sharing document specification, Health information exchange standard

(HL7) and other industry standards, establish a data basic management system, including data standard management, metadata management, terminology management, multi-center master data management, multi-center patient master index management. Achieve unified and standardized management of patient data in multiple medical institutions.

Data Aggregation

The open source architecture based on Hadoop is established based on the mode of separating storage and computing, and the offline batch data cleaning, conversion and loading are realized by using MapReduce computing power. At the same time, based on Hadoop open source architecture, spark stream computing capability is used to realize data cleaning, conversion and loading of real-time stream, and data modeling is supported according to different business fields such as patient domain, record domain, cost domain, and medical treatment domain to form unified and standardized data standards.

Data Governance

Establish the data standard mapping rule base to realize the mapping management of the multi-source heterogeneous source data to the standard data in 4 hospitals; With the patient as the dimension and the patient's single visit as the minimum particle size, the data of patients in different systems can be correlated to establish a complete patient data model. Develop data cleaning rules based on a series of common standards at home and abroad, such as Health Information Exchange Standard (HL7), CDA (Clinical Document Architecture Standard), electronic medical record basic architecture and data standard; Refer to the requirements of relevant documents to realize the desensitization and encryption of personal sensitive information; The normalized processing of the data of 4 medical institutions was realized, and the normalization and standardization of the field information expressed in different words but with the same meaning was realized through the synonym table of natural language and the synonym associative word list of medical terms, combined with the data mining algorithm, and the structured processing of the data was realized.

Data Quality Control

According to business requirements, establish data quality control rules to realize visual configuration of quality control standard classification, including standardization, consistency, accuracy, completeness, timeliness, etc., which can easily realize data asset overview, data asset query, and data asset details display.

Data Retrieval

Aiming at massive multi-dimensional medical data, Elasticsearch distributed retrieval technology is used to build a distributed query system and establish a variety of data retrieval methods, including keyword quick search, condition tree search, event search and precise search, so as to facilitate teachers and other researchers to quickly obtain the full-dimensional data of relevant patients.

Data Update

Real-time and timed data collection mechanism is adopted to realize the customized configuration of the priority, time and cycle of data synchronization to ensure that the main data can be displayed in real time. Meanwhile, case knowledge organization and dynamic update model are established to realize the "survival of the fittest" of cases, and the experience knowledge gathered by experts in historical cases is used to solve new management decision-making problems. Achieve fine management and precise service.

Privacy Security

Establish data information security protection system, data security application authorization management system, data transmission and storage security, covering hardware network, operating system, database, application software and management and other aspects of a unified, safe, stable and efficient information security system, at the same time for patients' sensitive data, encryption and desensitization mechanism, to protect patient privacy.

Developing and Implementing a Pediatric Clinical Teaching Case Library Based on Massive Real-Time Data

Developing Pediatric Real-Time Clinical Data Resource Set

This project utilized artificial intelligence data analysis techniques to sift through an extensive collection of authentic medical records, in real-time, obtained from the medical data center of the Army Medical University. The goal was to identify content suitable for pediatric clinical teaching while strictly adhering to domestic legal norms and industry standards. Meticulous data de-identification was carried out to anonymize 13 types of sensitive information, including patient names, ID numbers, phone numbers, and home addresses, ensuring robust protection of patient privacy.[5] The project also implemented a secure encryption and decryption mechanism for data handling. Patient case information, responsibly and legally sourced from affiliated hospitals, encompassed a wide range of clinical data such as examinations, tests, pathology, imaging, and medical records. This information was compiled into a comprehensive pediatric clinical real-time data resource set providing a rich repository of digitized clinical data for educational purposes.[6]

Developing Pediatric Real-Time Clinical Teaching Case Library

The case library is built upon the pediatric real-time clinical data resource set and incorporates a streamlined search mechanism for extensive case data by leveraging patient master indices and diagnostic names for retrieval. Through the search interface, users can quickly find relevant case data using a convenient search box, displaying results in a list format with both broad and specific search options to accommodate various requirements. Cases meeting teaching needs are selected and integrated into the library, ensuring that informed consent is secured for the utilization of clinical information. Subsequently, case videos and images are captured and stored, and the cases are enriched with detailed interpretations of tests and examinations, effectively connecting text with images to create exemplary teaching cases. The case library undergoes continuous updates and expansions following the outlined steps 2–6 in Figure 1.

Inclusion Criteria

(1) Case Representativeness: Selected cases should comprehensively cover various etiologies, conditions, ages, and genders, addressing crucial clinical practice issues to enhance their practical utility in clinical teaching. (2) Case Typicality: Included cases must exhibit clear clinical manifestations and diagnostic clues, facilitating learners in comprehending medical knowledge throughout the diagnosis and treatment process. (3) Informed Consent: Cases qualify for inclusion if patients or their guardians provide consent for the collection and utilization of their clinical information post medical record retrieval.

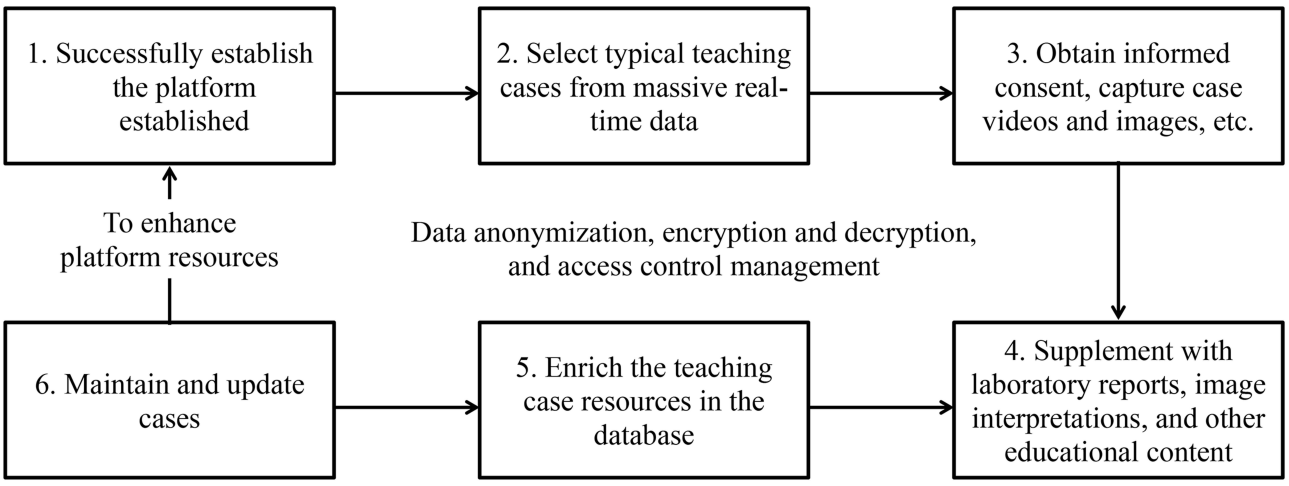

Figure 1 Teaching Case Database Construction Flowchart.

Exclusion Criteria

(1) Non-consent for Clinical Information Collection: Cases in which patients or guardians decline to share clinical information should be respected and excluded, prioritizing their privacy and preferences. (2) High Risk of Privacy Breach: Cases carrying significant patient privacy risks or likely to attract public attention should be approached cautiously, with a focus on preventing privacy breaches. (3) High Legal Dispute Risk: Cases potentially involved in legal disputes must be evaluated for legal risks with precedence given to legal considerations in order to prevent potential legal issues.

Dynamic Update Mechanism of the Pediatric Clinical Teaching Case Library

To maintain an optimal case size and consistently improve case quality the library employs a two-phase dual evaluation mechanism that focuses on "case inclusion—usage" and "quality—availability." This approach ensures the regular addition of high-quality cases and gradual removal of lower-quality ones, preventing unchecked expansion and facilitating dynamic knowledge updating.

(1) Case Inclusion Phase Evaluation: In this phase, case quality and usability undergo assessment through a human-computer integrated evaluation audit mechanism. Initial evaluations for case inclusion are conducted by experienced clinical professionals and qualified educators. A case evaluation knowledge database, serving as a training set, is created for the machine evaluation model. This model takes into account various factors such as patient follow-up loss, visit frequency, treatment feedback, and complication rates. Following the machine evaluation, cases undergo sample evaluation by experts with over 10 years of clinical and teaching experience and a minimum of an associate senior title. This iterative process ensures the continuous addition of high-quality cases.

(2) Case Usage Phase Evaluation: In this phase, educators and administrators evaluate the quality and usability of actively used cases. Assessment metrics encompass the effectiveness of the case in teaching, ease of use, and overall quality. *Effectiveness* gauges the impact of the case in clinical teaching, *ease of use* evaluates the accessibility and comprehensibility of case information, and *overall quality* encapsulates accuracy, comprehensiveness, and update frequency. The system examines data including usage frequency and analyzes average and variance of ratings to identify and remove cases that receive poor evaluations and demonstrate low usage rates.

Design and Implementation of a Real-Time Data Management System for Clinical Medical Education

A system is established to oversee the operation of the teaching cases within the library. This system organizes cases through classification, coding, and naming, offering three distinct levels of management permissions—student, educator, and administrator—aligned with different user roles.[7] Users can access and view teaching cases according to their assigned permissions, with educators and administrators having the ability to input or import external materials into the case material database. The system accommodates diverse resource formats, including text, videos, images, and graphics. It also supports the addition of annotations to case materials such as laboratory and diagnostic report interpretations and condition analyses. This real-time data management system for clinical medical education enables educational professionals to effectively oversee and utilize teaching cases, ultimately enhancing the quality and effectiveness of teaching.

Results

Construction Effect of Pediatric Clinical Teaching Case Database Based on Massive Real-Time Data

At present, the pediatric clinical teaching case database based on massive real-time data has integrated all pediatric diagnosis and treatment data of 4 medical institutions, including patient outpatient data, hospitalization data and emergency data, totaling 6,657,320 medical records. Among them, the number of outpatient medical records is 5491596, the number of inpatient medical records is 195283, and the number of emergency medical records is 970441. The time span of patient medical records ranges from 1997.11.26 to 2024.7.31.

Through this case database, all the diagnosis and treatment data of patients can be obtained. It includes the first page of medical records, medical history, diagnosis, symptoms, surgery, examination, examination, pathology, anesthesia, nursing, doctor's orders, physical examination, etc. At the same time, the platform has integrated 15,401 papers related to

pediatrics, 82 diagnosis and treatment guidelines, 30 case reports, 491 clinical studies, 357 research reviews, and 5 systematic reviews. At the same time, it has carried out teaching activities on pediatric related diseases such as Down syndrome, neonatal and neonatal diseases, neuromuscular system diseases, and supported the development of six clinical studies.

After teaching, we assessed the theoretical knowledge, clinical thinking and clinical skill operation of the study subjects, and conducted an anonymous questionnaire survey. Through assessment results, case discussion and questionnaire survey, the assessment results, teaching satisfaction, clinical thinking ability and learning ability of the two groups were obtained for analysis and comparison. The difference between the new method and the traditional teaching method was compared. SPSS21.0 statistical software was used for statistical analysis, and the measurement data were in line with normal distribution and represented by $\bar{x}\pm s$. The difference between groups was compared by independent sample *t* test. Counting data were represented by n(%), and x2 test was used for analysis among groups. $P<0.05$ was considered statistically significant.

Application of the Pediatric Clinical Teaching Case Library Based on Massive Real-Time Data

The pediatric clinical teaching case library supported by extensive real-time data offers authentic and high-quality data assistance for both theoretical and practical teaching in clinical medical education. It effectively addresses the challenge of promptly identifying typical cases during educational sessions. In situations where students struggle to find suitable cases during internships and practical sessions, educators can utilize real-case materials from the library, accessing medical records, videos, and images that depict actual clinical scenarios for instructional purposes.

Moreover, the case library serves as a valuable resource for guided instruction and case-based teaching in theoretical classes, injecting vitality into the teaching environment and enriching digital teaching methodologies. Additionally, it plays a pivotal role in curriculum development. It is crucial to emphasize that this teaching case library undergoes thorough data anonymization, replacing personal details such as names, addresses, and contact information, with randomly generated characters. This meticulous process ensures the elimination of any risk of patient privacy breaches effectively safeguarding patient information security. Specific application scenarios of the database include:

1. Remote Teaching Service: The platform has established an exclusive repository of teaching resources to support remote teaching, complementing traditional classroom methods and fostering a blended learning environment that overcomes geographical limitations.[8]
2. Teaching Case Retrieval: The system seamlessly integrates various educational resources, including library systems, electronic journals, and specialized academic databases. This integration eliminates barriers of time and space, facilitating easy access for educators and students to materials and book borrowing. It creates a comprehensive resource pool that enhances the overall teaching and learning experience.
3. Practical Teaching Service: The development of a clinical teaching case library based on real-time data resources allows students to immerse themselves in actual clinical scenarios and case progressions. This engagement enhances their practical skills and problem-solving abilities. Educators can promptly update teaching content based on the latest data resources, thereby improving the effectiveness and relevance of teaching.

In an illustrative course design centered on Trisomy 21 (Down syndrome), the curriculum references the *Pediatrics* textbook chapter on inherited metabolic diseases. The curriculum standard entails a comprehensive understanding of the clinical manifestations, cytogenetic typing, diagnosis, and differential diagnosis of Trisomy 21. However, due to the effectiveness of genetic counseling and prenatal screening, identifying Trisomy 21 patients for clinical teaching poses challenges. To tackle this issue we leverage the *pediatric clinical teaching case library based on massive real-time data*.

Upon conducting a search for *Down syndrome or Trisomy 21* in the database, we retrieve a substantial number of clinical cases (390 related cases and 468 case files). The search function allows filtering based on criteria such as visit type, admitting and discharge departments, admission time, patient age, and gender. Upon selecting a case, we have

access to detailed information, including number of visits to various departments like emergency, outpatient, and inpatient services. Additionally, the diagnosis for each visit is available for review. For example, by selecting a specific case from the main interface of the database users can access the visit history of the patient, visit history across various hospital departments, along with the results of each visit. In this particular case, the patient underwent 16 outpatient visits and was hospitalized once, attending clinics such as obstetrics specialist clinic (1 visit), COVID-19 screening clinic (1 visit), reproductive medicine center clinic (3 visits), gynecology clinic (1 visit), breast (thyroid) surgery clinic (1 visit), obstetrics midwifery clinic (1 visit), obstetric clinic (6 visits), postpartum rehabilitation clinic (1 visit), and prenatal diagnosis center clinic (1 visit). The sequence of diagnoses chronologically includes pregnancy at 22 +1 weeks with a history of four pregnancies and one cesarean section, awaiting induced labor, pregnancy at 22+4 weeks with induced labor due to fetal demise, purpura of the uterus, and diagnosis of fetal Trisomy 21 (Down syndrome) at 21 +4 weeks, accompanied by purpura of the uterus. These details suggest that the case involves a mother carrying a child with Trisomy 21 ultimately opting for induced labor.

In selecting another case of a child diagnosed with Trisomy 21 it is important to note that personal details have been anonymized. To illustrate the characteristic facial features of Trisomy 21 the case library includes photos depicting typical appearances. By accessing the physical examination or admission medical record of this case we can follow the diagnostic and treatment pathway of the patient which involved admission at four days old due to skin jaundice. During the admission, physical examination of the neonate revealed the following findings: a body temperature at 37.2°C, a respiration rate of 42 breaths per minute, a pulse rate of 140 beats per minute, a head circumference of 34 cm, and a body weight of 3.2 kg. While the infant exhibited normal growth there were signs of poor responsiveness. Physical characteristics included a flattened skull, depressed nasal bridge, short hard palate, upward slanting palpebral fissures, sparse hair, and significant jaundice on the face and sclera, extending to moderate yellowing of the palms and soles. The anterior fontanelle was open, measuring about 2.0×2.0 cm, soft and flat. The lips showed no cyanosis and there was no congestion in the throat. Normal findings were observed in the heart and lungs. The abdomen appeared full with a dry umbilical area and no purulent or bloody secretions. Neither the liver nor spleen were palpable below the ribs. The anus and external genitalia appeared normal. Limb movement was typical but muscle tone was low. Reflexes such as suckling and grasp were present along with positive rooting reflex and Moro reflex, and negative bilateral Babinski signs. Liver function tests indicated elevated GGT at 267 IU/L, normal AST at 41 IU/L, ALT at 15 IU/L, high total bilirubin (TBIL) at 256.9 μmol/L, and direct bilirubin (DBIL) at 6.4 μmol/L.

Additional tests, including complete blood count (CBC), routine urine and stool analysis, thyroid function, and reticulocyte count yielded results within normal limits. The initial hospital diagnosis comprised neonatal hyperbilirubinemia and Trisomy 21. The neonate underwent blue light phototherapy resulting in gradual improvement, particularly in skin jaundice. Chromosomal karyotyping confirmed Trisomy 21, revealing a karyotype of 47, XX, +21. Subsequent liver tests demonstrated reduced TBIL at 207.9 μmol/L and DBIL at 6.0 μmol/L. Following a discharge request by the parents and consultation with senior physician the infant was discharged in good overall condition. At discharge the infant exhibited slightly poor responsiveness, good sleep, effective feeding, normal bowel and bladder functions. The physical examination indicated mild jaundice on the sclera, face, and trunk, absence of lip cyanosis or throat congestion, clear lung sounds, a full abdomen, a dry umbilical area, normal limb movement with low muscle tone, and the presence of suckling and grasp reflexes, a positive rooting reflex and Moro reflex, and negative bilateral Babinski signs. This comprehensive information facilitates a thorough exploration of medical records offering a detailed chronological understanding of disease progression in a real-case scenario. Analyzing these records in sequence enhances the ability of students and physicians to effectively address practical clinical problems.

Discussion

Analysis of Domestic and International Research

Historically, the integration of case teaching with actual clinical cases has been a topic of interest in the educational field. Waliany et al championed this method as early as 2019, emphasizing its effectiveness in boosting student motivation and interest, which in turn enhances teaching outcomes.[4] In the pursuit of educational innovation numerous

universities and hospitals globally have taken steps to establish their own databases for remote teaching cases. Notably, in Germany, the *LOOOP share* online platform enables educators to share patient cases virtually, thereby enriching the clinical decision-making skills of students through case-based learning.[9] Despite these advancements there seems to be a noticeable gap in both domestic and international initiatives that focus on employing clinical teaching resources derived from real-time data and authentic cases. In many regions, despite an increasing appreciation for case-based teaching, the predominant practice still revolves around static case libraries.[10–12] The concept of clinical teaching case libraries based on extensive real-time data remains relatively unexplored and unadopted on a wider scale.

Advancement of Quality Resource Sharing Through a Teaching Case Library Based on Real-Time Data

Our institution has taken a pioneering approach in leveraging a genuine medical case database to elevate the quality of pediatrics education. This novel approach effectively utilizes clinical medical record resources from affiliated hospitals, providing substantial support for clinical teaching. The teaching case library, fueled by real-time data, encompasses a rich repository of distinctive and authentic clinical teaching resources, enabling a harmonious blend of theoretical and practical instruction. This initiative adds depth to theoretical teaching by incorporating clinically representative cases, thereby making the instruction more pertinent to real-world clinical scenarios. In contrast to simulated patients, it offers more realistic clinical scenarios for internships and practical teaching activities. Moreover, the search functionality of the case library caters to the active learning needs of students at various levels, creating an authentic, clinical, and intelligent learning environment.

This model not only facilitates the distribution of high-quality teaching resources but also encourages the development of interdisciplinary teaching. Through strategic collaboration with affiliated hospitals, we have seamlessly integrated a wealth of clinical medical record resources leveraging these practical experiences and knowledge for the collective benefit of faculty and students. This collaborative effort empowers educators to customize their teaching approaches by drawing insights from real cases within the database. This approach allows for case analyses and discussions that closely align with clinical practice, thereby enhancing the specificity and practicality of teaching. Students, in turn, benefit from a broader and more profound spectrum of learning experiences which enhances their clinical reasoning and practical skills.

The successful implementation of this innovative model has significantly enriched the educational and teaching resources available at our institution. The case library offers teaching cases of substantial clinical practical value by fully leveraging real-time data resources. It effectively supports interdisciplinary integrated teaching and fosters student-led learning. Moreover, this model lays a strong foundation for future technological advancements and evolving clinical practices in the medical field.[13]

Future Prospects

We established a pediatric clinical teaching case library based on real-time data and plan to extend it to other departments for further research on the application of real-time data resources in other specialty areas. Since our platform integrates medical data from all clinical departments, it has strong potential for broader implementation. Additionally, we plan to enhance the platform by integrating it with mainstream databases, including electronic books, journals, and clinical data repositories. This comprehensive integration will unlock a range of services encompassing electronic book lending, teaching resource searches, and open link services, all consolidated within a single platform. Such integration will provide users with a more extensive and diverse resource pool, thereby significantly enhancing the convenience and quality of education and teaching. Ultimately, a clinical case library grounded in massive real-time data will play a crucial role in helping students better comprehend and tackle clinical challenges, enhancing their practical skills, while concurrently supporting educators in refining their digital teaching methodologies.

Conclusion

We have successfully established a pediatric clinical teaching case library by harnessing a vast array of real-time data resources. This library has been designed to support both clinical and theoretical teaching by providing a comprehensive repository of digitally archived clinical cases. To ensure the utmost security and privacy protection, we have implemented data anonymization, secure data transmission, and robust encryption and decryption protocols. The library not only enriches case-based teaching but also enhances the overall quality of medical education. Moving forward, we plan to further develop data-driven teaching methodologies, which will facilitate continued innovation and advancement in medical education.

Data Sharing Statement

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

This study was conducted with approval from the Ethics Committee of Third Military Medical University (Army Medical University). This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants and their guardians.

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Disclosure

The authors declare that they have no competing interests.

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