
THE INTEGRATED COMPONENT-BASED KNOWLEDGE MANAGEMENT SYSTEM (ICB-KMS) FOR MENTAL HEALTHCARE

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ABSTRACT

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The importance of mental health in the world needs special attention. A country with a dense and high population, such as Indonesia, is known to be vulnerable to the prevalence of mental disorders due to the pressure of various factors such as work, social, cultural, and environment. The high number of mental disorders threatens the country's economy because they are not optimally productive. Currently, accurate mental health data is complex due to stigma and a lack of understanding and knowledge in society. This research aims to apply the integrated component-based knowledge management system (ICB-KMS) framework for mental health. The study was conducted in five mental hospitals in the A category using quantitative and qualitative methods. More than 200 pieces of data were collected from practitioners and healthcare professionals (doctors and psychiatrists), medical staff, nurses, management, stakeholders, and policymakers. Four of the seven phases of the ICB-KMS framework were successfully carried out, i.e., requirement analysis, system design and architecture, knowledge acquisition and integration, and user interface design interaction. The result is a blueprint of ICB-KMS with functional and non-functional systems and application architecture.



Introduction

The scientific development of information systems is rapid because they are supported by various Information Technologies (IT) that enable them to be realised, especially in Artificial Intelligence (AI). One of the disciplines that involves experts or specialists is Knowledge Management (KM). The application of KM supports organisations in competing and improving service quality in business processes. This KM field has been applied in various organisations and industries. In the health sector, it is known as Healthcare Knowledge Management (HKM), Hospital Knowledge Management (HKM), and Clinical Knowledge Management (CKM).

Mental health is defined as the state of a person who can achieve mental well-being and is a part of general health. It cannot be separated from physical health because if it is not well maintained, it can also affect physical health. For example, when someone has mental health problems, it will cause psychosomatic symptoms (Theng, Dafit, & Fransen, 2023). Forms of mental disorders can be various, such as anxiety disorders, mood disorders, psychotic disorders, and eating disorders. In more severe circumstances, a person can have schizophrenia, which makes it difficult to differentiate between real life and fantasy. According to Basic Health Research (Kesehatan, 2018), there are more than 19 million teenagers aged over 15 years who have mental and emotional disorders. In

addition, more than 12 million people in the same age range are known to experience depression. Mental disorders like this can cause sufferers to take reckless actions such as committing suicide.

According to (Hasanah, 2020), 4,304 people with mental disorders (ODGJ) in Indonesia were detected living in shackles until the second quarter of 2022. Based on data from the Ministry of Health, the number of ODGJ undergoing shackling in 2019 reached 4,989 people, 2020 (6,452 people), 2021 (2,332 people), and in the second quarter of 2022 (4,304 people). Therefore, the efforts to free ODGJ should involve related professional organisations through an educational approach to families and the surrounding community.

Sample Registration System data collected by the Research and Development Agency for 2016 found that approximately 1,800 people commit suicide every year. This figure means that, on average, five people commit suicide every year. Sadly, it is known that around 47.7 per cent of the suicide perpetrators were aged 10-39 years. This group is included in the teenage and productive age categories. Quoting the Healthy My Country page of the Ministry of Health, Indonesia has a prevalence of people with mental disorders of approximately 1 in 5 people. If it is related to a population of 265 million people, the number of those vulnerable to mental disorders reaches 20 per cent of the population in this country.

Another obstacle is that not all provinces have mental hospitals that people with mental disorders can access to get proper treatment. Another problem in dealing with mental disorders is the bad stigma attached to sufferers. People suffering from mental disorders should get support so they can recover quickly and get their everyday lives back. On the other hand, people with mental disorders are discriminated against, and their human rights to receive appropriate treatment are not fulfilled (Hasanah, 2020). Meanwhile, Indonesia found 9,162,886 cases of depression, with a prevalence of 3.7 per cent. On the other hand, Indonesia's population can increase yearly to more than 3 million people, which has now reached 278,16,661 people. The number of depressed people may be much more significant. According to data published on the Our Better World page from the 2013 Ministry of Health data, around 9 million Indonesians experience depression. As a result, 3.4 suicide cases were found per 100,000 people in Indonesia. Around 16 million people aged 15 years and over, cases of suicide were found to be initiated by symptoms of anxiety and depression by the perpetrator. Suicide cases are also triggered by more severe mental illnesses such as psychosis, with a figure of around 400,000 people. There are also 57,000 people suffering from mental disorders who are confined to their surroundings.

Depression has also been experienced by Indonesian teenagers, causing 19 per cent of them to have suicidal thoughts. As many as 45 per cent of teenagers have even taken action to harm themselves. Quoting the Institut Teknologi Sepuluh Nopember (ITS) page, in the opinion of Universidade Federal do Rio Grande do Sul professor Christian Kieling, MD. PhD estimates that the increase in depression experienced by teenagers has increased by 10-20 per cent every year. Meanwhile, in 2019, WHO recorded that around 300 million

people worldwide had experienced depression. As many as 15.6 million of them came from Indonesia. According to I-NAMHS research published in 2022, as quoted from the Universitas Gajah Mada (UGM) website, there are several risk factors related to the emergence of mental disorders in adolescents. These factors include bullying, school and education, peer and family relationships, sexual behaviour, substance use, childhood trauma experiences, and the use of health facilities. Teenagers who experience mental disorders experience problems or difficulty carrying out their daily activities. The research also found that 1 in 3 Indonesian teenagers have health problems between the ages of 10-17 years. This figure is equivalent to 15.5 million teenagers. The types of mental disorders that many teenagers suffer from are anxiety disorders (a combination of social phobia and generalised anxiety disorder) 3.7%, major depressive disorders (1.0%), behavioural disorders (0.9%), and post-traumatic stress disorders (PTSD) and attention deficit hyperactivity disorder (ADHD) with rates of 0.5% each. Thus, the World Health Organization (WHO) reported that Indonesia has a 2.55 age-standardized suicide mortality rate (per 100,000 population). It is shown on Mental Health Atlas 2020 (Fig. 1) (World Health Organization, 2020).

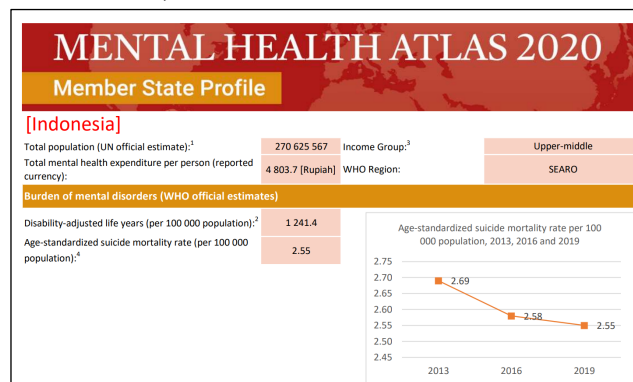


Figure 1 Indonesian suicide mortality rate (WHO, 2020)

However, the mental health workforces in Indonesia have an amount of 8.135 people as mental health professionals (Fig 2.)

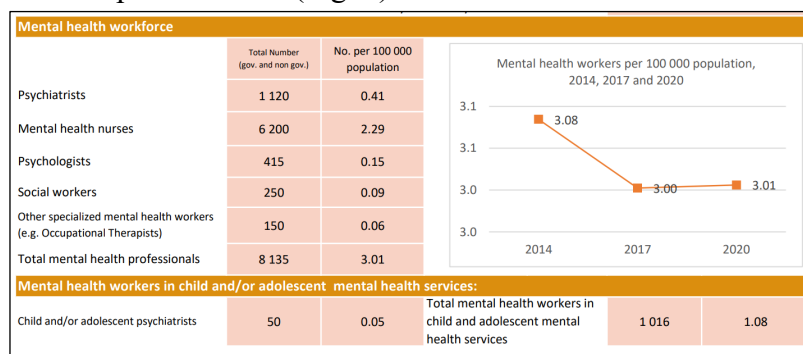


Figure 2 The mental health professional in Indonesia (WHO, 2020)

Based on Government Health Research (Riskesdas, 2018) shows that the prevalence of schizophrenia/psychosis in Indonesia is 6.7 per 1000 households. This

means that out of 1,000 households, 6.7 households have household members (ART) who have schizophrenia/psychosis. The highest prevalence distribution is in Bali and Yogyakarta, with 11.1 and 10.4 per 1,000 households with assistant housekeepers (ART). In general, the results of the 2018 Riskesdas research also stated that 84.9% of people with schizophrenia/psychosis in Indonesia had received treatment. However, those who take medication irregularly are slightly lower than those who take medication regularly. It was recorded that 48.9% of people living with psychosis did not take medication regularly, and 51.1% took it regularly. As many as 36.1% of sufferers who did not regularly take medication in the last month said they felt healthy. As many as 33.7% of sufferers do not routinely seek treatment, and 23.6% cannot afford to buy medicine regularly (Jayani, 2019).

Hence, the Integrated Component-Based Knowledge Management Systems (ICB-KMS) Model for Healthcare was implemented, where patients can monitor their treatment and medication. ICB-KMS is a proposed model that integrates all the integral components of an effective KM system with an efficient KM process framework. This model is designed to build KMS in health services and to provide effective governance. This model is based on the idea that KM includes strategies, processes, and practices that enable organisations to capture, share, store, access, and use knowledge. KM tools that facilitate the capture and distribution of clinical knowledge are becoming critical, especially for healthcare organisations, to maintain quality of care. Advances in health information and communication technology, clinical decision support systems, electronic health record systems, communities of practice, and advanced care planning are some of the available opportunities that can be exploited to apply KM in health care and improve the quality of care for patients. Empirically based models for KM in healthcare organisations highlight the importance of context (internal and external), knowledge seeking, synthesis, sharing, and organisation. This model proposes different knowledge sources to support innovation and improve performance (Shahmoradi, Karami, & Nejad, 2016) (Sibbald, Wathen, & Kothari, 2017).

Research Methods

The development of KMS for mental disorder applications used the ICB-KMS framework. The data collection, both quantitative and qualitative, is conducted for one year. The data gathering is carried out through observations in five mental hospitals. The category of mental hospital is class A, which represents having more than 500 beds and is supported by a complex of business processes such as inpatient, outpatient, polyclinic of physical and mental, laboratory, electronic treatments, carrying drugs addicted, hospital teaching, laundry management, etc.

The questionnaire respondents are 150, whereas the informants are 50. Mental health professionals (psychiatrists, nurses, medical staff, doctors, administration staff, laboratories, management (middle and top), stakeholders, and decision-makers) exist. The phases of the ICB-KMS framework consist of: Phase 1: Requirements Analysis (observation and interaction); Phase 2: System Design and Architecture (using Rapid

Application Development (RAD) and Unified Modeling Language (UML); Phase 3: Knowledge Acquisition and Integration (using KMS); Phase 4: User Interface and Interaction; Phase 5: Collaboration and Knowledge Sharing; Phase 6: Security and Compliance; and Phase 7: Evaluation and Continuous Improvement. This article only presented four phases (1-4).

Results and Discussion

Developing an ICB-KMS Model for healthcare involves a comprehensive system that leverages components to efficiently manage and utilise knowledge within the healthcare domain. The phased approach to developing such a model includes the integration of integral components of an effective KM system with an efficient KM process framework, as well as the utilisation of available opportunities, such as advances in healthcare information and communication technology, clinical decision support systems, and electronic health record systems (Arshad, Noordin, Bint Othman, & Mehmood, 2018) (Shahmoradi et al., 2016). The model aims to facilitate and improve healthcare service delivery, address challenges that limit KM implementation in healthcare, and promote evidence-based decision-making. It is considered an essential and integral tool for efficient and effective healthcare governance, with the potential to transform healthcare through utilising KM. Creating an ICB-KMS Model for Healthcare involves designing a comprehensive system that leverages components to efficiently manage and utilise knowledge within the healthcare domain. Below is a phased approach to developing such a model.

Phase 1: Requirements Analysis

The requirements analysis phase of developing an ICB-KMS for healthcare involves defining the functional and non-functional requirements of the entire system (Benfell, 2021). This phase is crucial in identifying the needs and expectations of stakeholders, including healthcare providers, patients, and administrators, and in determining the scope and objectives of the KM system (Fig 3.). The requirements analysis phase is followed by the KM architecture design and component selection phase. This phase aims to design a KM system that meets the identified requirements and aligns with the organisation's strategic goals. The output of this phase is a blueprint for the KM system. The objectives should be specific, measurable, achievable, relevant, and time-bound. This could include improving patient care, enhancing decision-making, and fostering collaboration among healthcare professionals.

support the organisational need. The architecture has been proven using Focus Group Discussion and development.

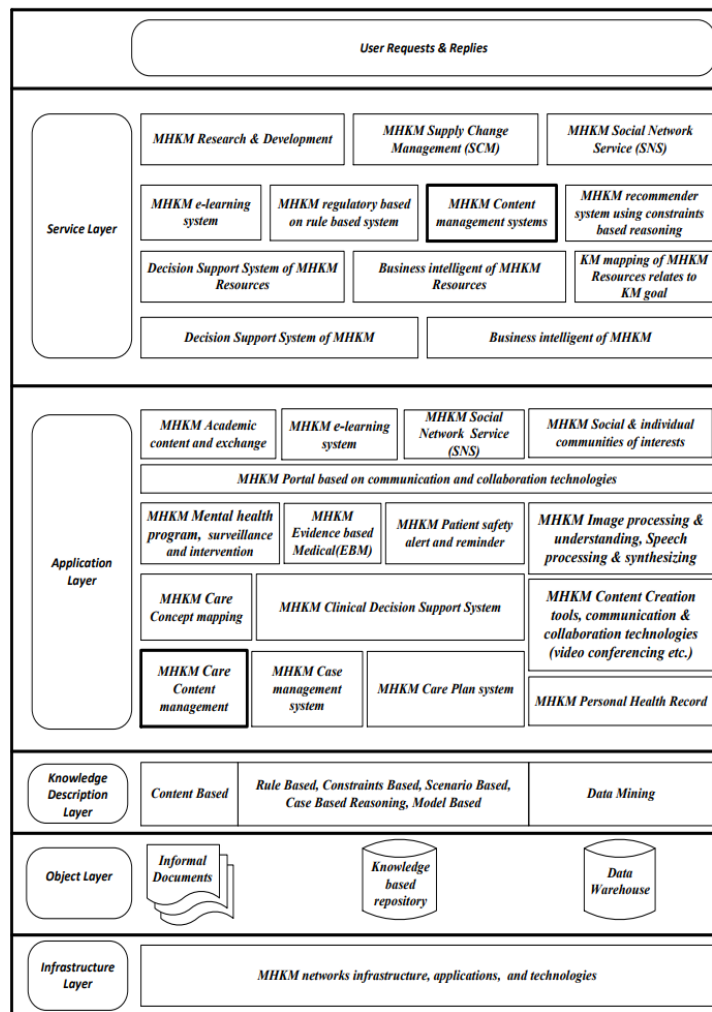


Figure 4 ICB-KMS Mental Health Architecture

According to (Nikolaychuk, Pavlov, and Stolbov, 2018), a component-based architecture for a healthcare KM system could include the following components of knowledge portals (interfaces that provide access to the KM system, allowing users to search, retrieve, and share knowledge) and knowledge repository (a central repository that stores and manages the organisation's knowledge assets, including documents, data, and other information). It also may include a Database Management System (DBMS) to store and manage healthcare knowledge and information; a Content Management System (CMS) for organising and presenting healthcare content and resources; and Data Analytics and Business Intelligence Tools to analyse healthcare data and extract meaningful insights.

Phase 3: Knowledge Acquisition and Integration

This phase is crucial for ensuring that the KM system is populated with relevant, up-to-date, high-quality knowledge to support decision-making, problem-solving, and

innovation within the healthcare organisation. The process of knowledge acquisition and integration typically involves the knowledge sources, knowledge quality, codifying, storing, integrating, maintaining, and updating knowledge (Fig. 5). By following these steps, the healthcare organisation can effectively acquire and integrate knowledge into the KM system, ensuring that it is well-equipped to support decision-making, problem-solving, and innovation in the healthcare domain (El-Farr & Hosseingholizadeh, 2019).

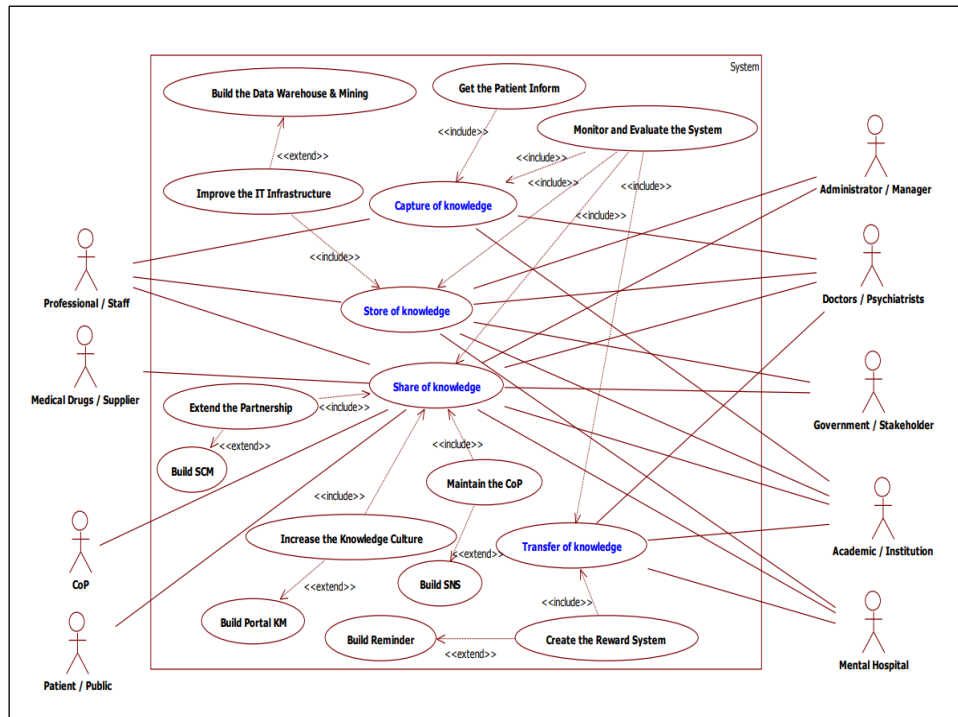


Figure 5 ICB-KMS Mental Health Activities and Processes

In the context of KM activities, "knowledge capture" refers to acquiring and documenting knowledge to make it available for use within an organisation. This process involves identifying, collecting, and storing knowledge from various sources, including individuals, documents, and external repositories. Knowledge capture is essential for preserving institutional knowledge, enabling knowledge sharing, and supporting decision-making and innovation. The Meyer and Zack Knowledge Management Cycle (KMC) emphasises capturing information through its acquisition phase and organising knowledge through refinement, storage, and retrieval. This cycle highlights the importance of capturing, organising, storing, retrieving, distributing, and maintaining existing internal and external knowledge. Furthermore, the McElroy KMC evaluates knowledge and its integration into the organisational memory. This cycle involves processes such as knowledge production, which includes individual and group learning, knowledge claim formulation, and information acquisition, followed by knowledge integration, which aims to integrate the evaluated knowledge into the organisational memory. Knowledge capture is a fundamental step in the KM process, and it involves systematic approaches to acquiring, organising, and storing knowledge to ensure its availability and usability within an organisation (Dahiyat, 2015).

Integrating existing systems is critical to developing a healthcare knowledge management (KM) model. It involves connecting new KM systems with legacy systems and other healthcare applications to ensure seamless data exchange and interoperability. This integration is essential for leveraging the power of existing systems and accessing data across various platforms to create efficiency in healthcare processes, including payments and patient care. Successful integration requires careful consideration of legacy system integration, middleware, APIs, and bespoke programming to ensure data migration is conducted precisely and securely. Additionally, the integration process should be closely monitored to maintain the security and integrity of the healthcare environment, and healthcare personnel should be trained to utilise the new integrated system efficiently. The integration of healthcare systems is vital for improving communication, data accessibility, and patient care coordination, ultimately leading to superior performance in terms of quality and safety (Lee Ventola, 2014).

Phase 4: User Interface and Interaction

The "User Interface and Interaction" phase involves designing and developing the User Interface (UI) to ensure the KM system is user-friendly and intuitive and effectively supports knowledge access and utilisation. This phase encompasses the following key aspects: UI Design for creating a visually appealing and intuitive interface that enables healthcare professionals to easily access and interact with the knowledge resources within the system; Usability Testing for conducting usability testing to ensure that the UI meets the needs of the end users, such as healthcare providers, administrators, and other staff members; 3 Accessibility for ensuring that the UI is accessible to all users, including those with disabilities, and complies with relevant accessibility standards; Integration with Existing Systems for integrating the UI with existing healthcare systems to provide a seamless user experience and ensure interoperability; and Training and Support for providing training and support to users to navigate and utilise the KM system's UI effectively. Figure 6 shows that ICB-KMS Mental Healthcare can interact between users. The doctors, psychiatrists, nurses, and staff of the mental hospitals were facilitated to monitor and communicate with each other. Sometimes, when patients leave or move to other cities, they can still get medication, especially the treatment they have taken.

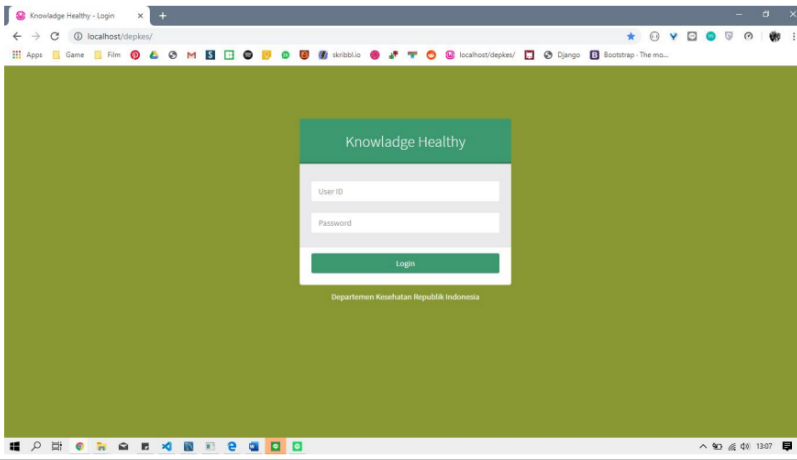
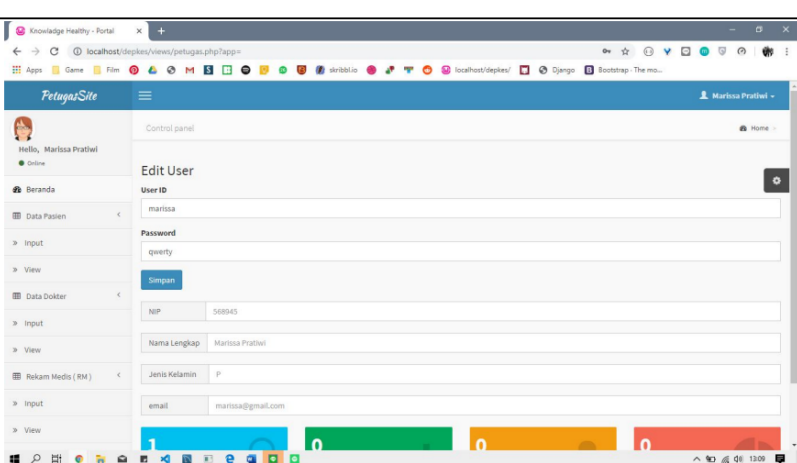
Menu AH	Pages
<p><i>Login into system</i></p>	
<p><i>1.0 Home display AH (edit user AH)</i></p>	

Figure 6 The User Interface of ICB-KMS Mental Healthcare (one of the samples)

User-Centric Design (UCD) is crucial in revolutionising healthcare technology by enhancing accessibility, usability, and efficiency. By integrating UCD into product design, a patient-centric approach in healthcare can be achieved, resulting in streamlined workflows and user-friendly tools for healthcare professionals, ultimately enabling them to provide the best possible care. UCD involves understanding and responding to human needs through a systemic, humane approach and creativity. It also emphasises the importance of engaging stakeholders throughout the design process and adopting a systems approach by addressing interactions between different levels of sociotechnical care systems. Additionally, UCD is essential for improving electronic health record (EHR) usability and safety, as poor EHR design and usability can lead to errors that compromise patient safety and contribute to provider burnout. Therefore, UCD is a critical methodology for developing healthcare technologies that effectively meet the needs and expectations of users, ultimately improving the quality of care and patient outcomes (Lee Ventola, 2014) (Melles, Albayrak, & Goossens, 2021).

Conclusion

Developing an ICB-KMS Model for Healthcare aims to enhance the healthcare domain's efficiency, collaboration, and decision-making processes. This comprehensive model involves a phased approach, starting with requirements analysis, system design, and architecture and progressing through knowledge acquisition, user interface design, collaboration tools integration, and security implementation. By incorporating modular and scalable components, such as a knowledge repository, search and retrieval systems, collaboration tools, and decision support systems, the model is designed to accommodate the complex and dynamic nature of healthcare information. The user-centric design and mobile accessibility prioritise the seamless integration of knowledge management into healthcare professionals' daily workflows, fostering a culture of continuous learning and collaboration. The ICB-KMS Mental Healthcare is a valuable asset in optimising patient care, improving decision-making processes, and empowering healthcare professionals with the knowledge and insights needed to navigate the complexities of the healthcare domain. Through thoughtful planning, technological innovation, and a commitment to user-centric principles, this model has the potential to contribute significantly to the advancement of healthcare KM. The future of research should emphasise interoperability and compliance with healthcare data standards, ensuring seamless integration with existing healthcare information systems while maintaining the highest data privacy and security standards. The model also recognises the importance of user training, change management, and feedback mechanisms to encourage active participation and facilitate a smooth transition towards a knowledge-sharing culture. There are several potential areas for future research related to developing an ICB-KMS Model for healthcare. It can explore how the complexity and emerging technologies such as IoT, BIG Data, Artificial intelligence (AI), and so on are more sophisticated. This could involve using speculative fiction, historical insights, and feminist perspectives to imagine possible futures and inform present decision-making.

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