

## Applied Healthcare Knowledge Management for Hospital in Clinical Aspect

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### **Abstract**

*Medical industry uses the information as a critical factor in running the three aspects of hospital management which includes administrative, financial and clinical. Objectives to be achieved is to identify healthcare knowledge resources and models of knowledge sharing, identifying culture, strategy and knowledge management supporting facilities, plotting knowledge resources and mapping supporting features of knowledge portals as well as doing analysis and design of healthcare knowledge management portal that developed. In achieving the purpose of analysis and design of healthcare knowledge management portal, is done through several stages of the methodology, where the identification process carried out primary and secondary data collection, while the analysis on the management aspects was performed cultural analysis with OCAI methods and the analysis and design of information systems with OOAD approach using UML models. PELNI Hospital is using for this case study. From analysis and design of healthcare knowledge management portal is expected to get a picture of the current organizational culture and the expected culture, the description of network infrastructure and organizational strategies related to resource and knowledge destination to produce a Knowledge Management Portal.*

**Keywords:** Knowledge capability, Object oriented analysis and design, Logical model

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### **1. Introduction**

Information Technology as technical aspects in the development of various applications and information-based mechanisms provide new core competency in its application to any part of the intellectual process, especially in the aspect of the business, where the mutual information is the main basis in providing competitive value of the business processes of an industry [1-4]. Medical industry (such as hospitals) use the information as a critical factor in running the three aspects of hospital management which includes administrative, financial and clinical.

The medical industry (such as hospitals) using information as a critical factor in running the three aspects of hospital management which includes administrative, financial and clinical. From the clinical side of medical is often happened conflict known by the term "malpractice. From 2006 through 2012, there were 182 cases of medical negligence --or plain language malpraktek-- proven by physicians throughout Indonesia. Malpractice is proven to be a doctor after going through the hearings of the Honorary Council of Indonesian Medical Disciplinary [5]. This shows a significant growth of malpractice cases in Indonesia and the dominant factor causing these cases is the lack of knowledge of medical practitioners regarding the handling of a medical case, a medical procedure that should be run (such as informed consent) and the standards of the medical profession, as well as the possibility of losing knowledge of senior medical practitioners and paramedics who leave the health institution, it is seen from the high rate of turnover of medical workers every year.

In this case, the Hospital as actors in the medical industry would face the same critical case in achieving competitive position but with the support of integrated information systems and internal networking in business process provide an opportunity to accommodate and manage knowledge. With the support of knowledge management then the cycle of knowledge within the scope of medical will help clinicians to interpret the knowledge and wisdom in analyzing medical data and establish medical diagnosis as well as minimize human error.

Knowledge has become a very important concept in the business world. However, previous studies about what is knowledge are still controversial. First, the characteristics of knowledge have been categorized from many perspectives. However, no one agreed set of definitions has been identified. For example, Ref [6] classifies knowledge into two categories: explicit knowledge and tacit knowledge. Explicit knowledge can be codified and shared in the form of hard data, manuals, codified procedures or universal principles, while tacit knowledge results from an individual's experience and is only revealed through its application. Ref [7] proposes that knowledge can be held by individuals or collectivity. Collective knowledge comes from knowledge integration: it is the combination of the coordinated efforts of several individuals who hold different but complementary skills [8].

Ref [9] defines knowledge as a fluid mix of framed experience, value, contextual information and expert insights that provides a framework for evaluating and incorporating new experiences and information. Drawing on the work of [6], [10] explicated two dimensions of knowledge in organizations: tacit and explicit. Tacit knowledge which comprised of both cognitive and technical elements [11], [12] is sourced in action, experience and involvement in a specific context. The cognitive elements in tacit knowledge refer to an individual's mental models and technical component consists of know-how, skills and crafts that apply to a specific context [10], [12]. The explicit dimension of knowledge is articulated, codified and communicated in symbolic form and/or natural language.

In its development since 1970, the medical industry experienced a silent transformation from a practical based model to a knowledge based model. This is done to coordinate distributed knowledge in the form of tacit knowledge that has not been structured and documented among medical practitioners in conducting medical services activities, as well as the chance of loss of knowledge from medical practitioners and senior paramedics who leave health institutions, this is viewed from the high turn rate Over from medical workers every year. Knowledge Management (KM) is a deliberate, systematic business optimization strategy that selects, distills stores, organizes, packages, and communicates information essential to the business of a company in a manner that improves employee performance and corporate competitiveness [13]. Knowledge Management is a process that helps organizations manipulates important knowledge that comprises part of the organization's memory, usually in an unstructured format. For an organization to be successful, knowledge, as a form of capital, must exist in a format that can be exchange among persons. In addition, it must be able to grow [14].

Therefore, required an alternative solution that can minimize the risk, which in this case by the use of a analysis and design method of knowledge-based management that focuses on the medical service process known as "Clinical or Healthcare Knowledge Management", which in its development requires a variety of resources (includes: people, data and information as well as hardware and software) in accordance with the degree of maturity on the processing and utilization of knowledge in the medical institution. Development of healthcare knowledge management portal focused on the clinical aspects of hospital management in the form of explicit documentation that can be stored, manipulated and accessed again by the medical staff (doctors, paramedics and medical personnel) in the field of medical of inpatient and outpatient care. The discussion is done through three (3) phases, as follows: (1) Identify (collection) of analytical data; (2) Analysis needs of healthcare knowledge management; (3) Design hospital's healthcare knowledge management portal.

Healthcare is experiencing an exponential growth in the scientific understanding of diseases, treatments and care pathways. But, this growth of knowledge is not congruent with our ability to effectively disseminate, translate and apply current healthcare knowledge in clinical practice [15]. Healthcare Knowledge Management (HKM) can be characterized as the systematic creation, modeling, sharing, operationalization and translation of healthcare knowledge to improve the quality of patient care [15]. Healthcare knowledge is complex both in form and function [16]. According to Ref.[15], knowledge types that directly contribute to clinical decision-making and care planning.

Activities from HKM Portfolio [15], consist of: A) Capturing, re-displaying, modeling, organizing and synthesizing different modalities of healthcare knowledge to realize comprehensive, validated and accessible healthcare knowledge resources; B) Access, share, disseminate current and case-specific knowledge on healthcare stakeholders in useful formats.

C) Operationalize and use healthcare knowledge, in clinical workflows, provide pragmatic patient care services, such as decision support (DSS) and maintenance planning, at point of care and point of need.

The types of knowledge that directly contribute to clinical decision making and care planning according to [15]: 1. Patient knowledge brings a clear description of the patient's health status encapsulating the medical relations between the various observations of the patient and the intervention shown by the physician, including capturing and recording in medical records, to provide a complete picture of the patient; 2. Practitioner knowledge is tacit knowledge relating to practice that is hidden by practitioners and trained at the time of carrying out medical treatment obtained through learning, internship, observation and experience; 3. Medical knowledge is the core domain knowledge describes the theories about health and health services, models and processes of delivery of health services; 4. Resource knowledge is a qualification of the delivery resources of care and infrastructure available in a health care setting; 5. Process knowledge considers the pathway (or flow of work) of specialized institutional care that determines the prescribed discourse of care for a medical condition in a health care setting; 6. Organizational knowledge represents organizational structures and policies that are trained by health care institutions that carry the flow of information and knowledge within the organization; 7. Relationship knowledge that describes social capital hidden in the organization, a community of health care providers or even individuals. Basically, relationship knowledge provides an understanding of how the knowledge sought and shared can be effected among healthcare professionals. In practice, knowledge helps in asking the right questions to the right person; 8. Measurement knowledge specifies the metrics, criteria and standards for measuring the success of the health service delivery process/delivery system and associated health outcomes.

## 2. Research Method

In achieving the purpose of analysis and design of healthcare knowledge management portal, is done through several stages of the methodology and PELNI Hospital is chosen to be the case study for healthcare knowledge management. The first stage will be collecting data from primary data and secondary data. While primary data will be covers from observation, interview and survey. Direct observation in the hospital for analyzing internal business activities (medical services) running and determine the parts of the system that can integrate with healthcare knowledge management to be designed. Interview, preparing several questions schematic that will be used in conducting debriefing sessions well with your IT department regarding support facility knowledge management and division Services and Marketing on organizational strategy and knowledge possessed by PELNI Hospital as well as to medical practitioners to obtain real information from the medical services. Survey will conduct by Giving form to the question IT division, and Marketing Services division and Medical Practitioner to know the culture of the organization. And secondary data will be gather from literature review and books.

Method of implementation will be using Object Oriented Analysis and Design using UML [17]. The development will cover logical data modeling (includes: class diagrams, usecase diagrams and sequence diagrams) and physical data modeling (including: user interface diagram) is needed in the development of healthcare knowledge management portal that refers to the use-based design methods Object Oriented Analysis and Design.

## 3. Results and Analysis

In this section, it is explained the results of research and at the same time is given the comprehensive discussion. Results can be presented in figures, graphs, tables and others that make the reader understand easily [2],[5]. The discussion can be made in several sub-chapters.

The first stage of development of healthcare knowledge management (HKM) is done through a process of identifying the various internal aspects of PELNI Hospital that can support and/or supported by HKM portal including aspects of management that consists of organizational structure and clinical activity at PELNI Hospital as well as aspects of information systems consists of knowledge resources and supporting infrastructure system of HKM portal. Organizational structure, in particular, Services and Marketing division, described the process of

sharing knowledge (including the dissemination and adoption) that are directly related to the clinical activity of the inpatient and outpatient care's installation. Figure 1 shows organization structure of PELNI hospital

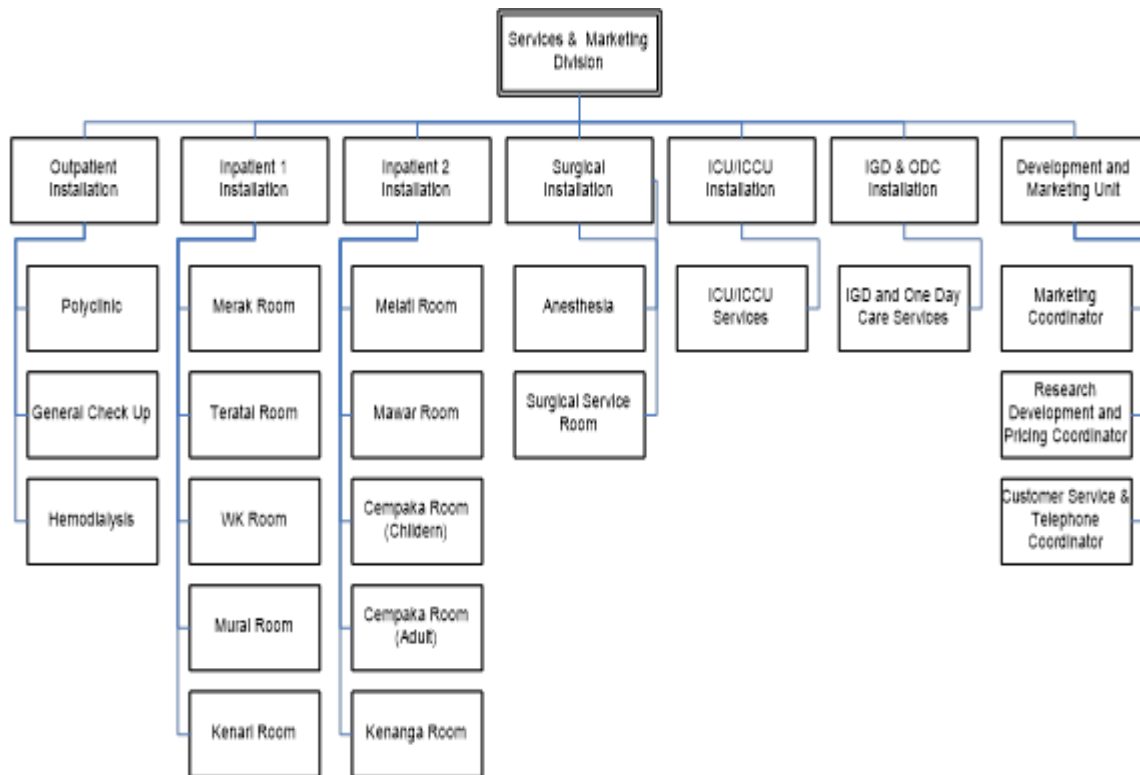


Figure 1. Organization structure of PELNI hospital

Clinical activity in of healthcare development knowledge management aspects took a major part of the business process on the inpatient and outpatient care's installation of PELNI hospital which becomes the basis for identifying the needs of users in the HKM portal, which include:

- Initial diagnosis stage: diagnosis of medical symptoms that looked at condition of the patient information and analysis the history of diseases that contained in medical history.
- Examination stage: clinical examination (physical) and investigations (including laboratory and radiology) for the patient's condition in general and the specific organ systems.
- Differential diagnosis stage: a systematic diagnosis of a list of causes that might lead to medical symptoms based on history and physical examination.
- Medical conclusion stage: the medical practitioner gave the final diagnosis and provide medical treatment both symptom and causal.
- Medical investigation stage: includes preparation of space and supporting facilities as well as the possibility of providing additional medical treatment (such as operating room).
- The final execution stage: the final examination of the patient's condition, make an entry medical treatment into the medical record, as well as examination of published evidence.

Healthcare knowledge resources identified through clinical activities that contribute either directly or indirectly for medical practitioners on the installation of inpatient and outpatient care are distributed in fourteen categories of knowledge, as seen on Table 1.

The second phase of the development of healthcare knowledge management (HKM) is the analysis phase, divided into two aspects: the analysis of organizational culture and organizational strategy analysis on which to base an assessment of whether the development would be succeeding and HKM will get support from both management and medical practitioners.

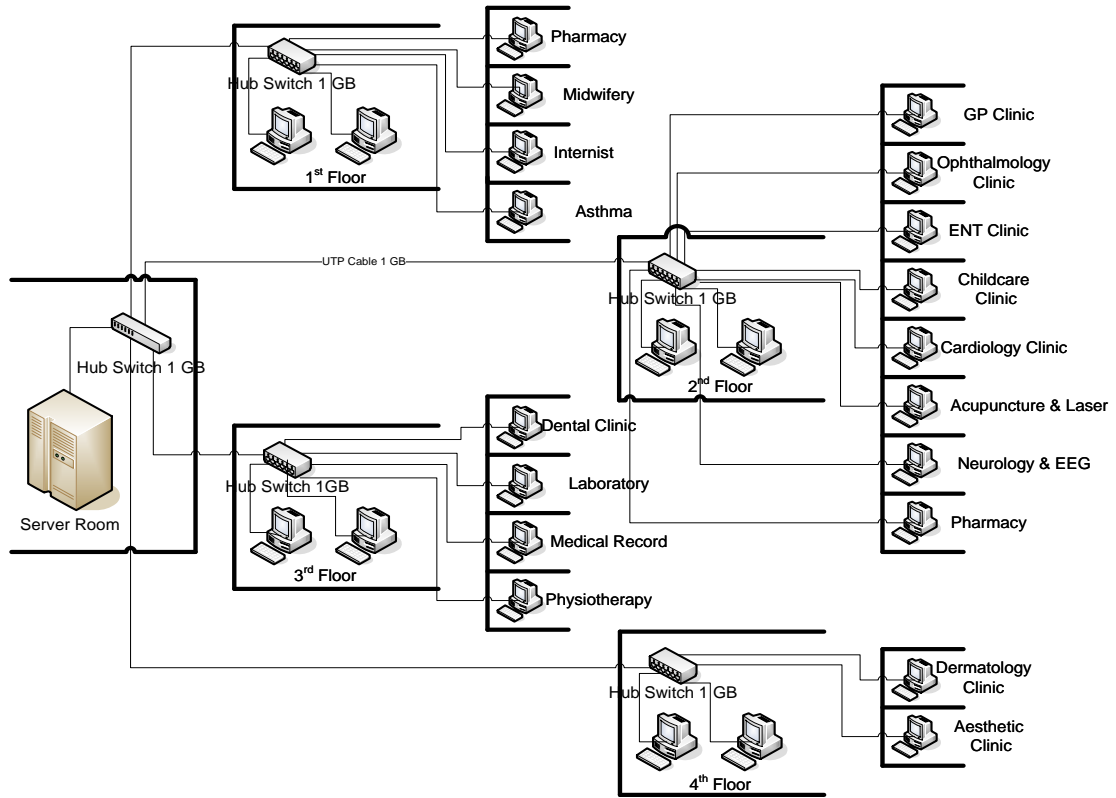


Figure 2. Network system and hardware infrastructures for outpatient

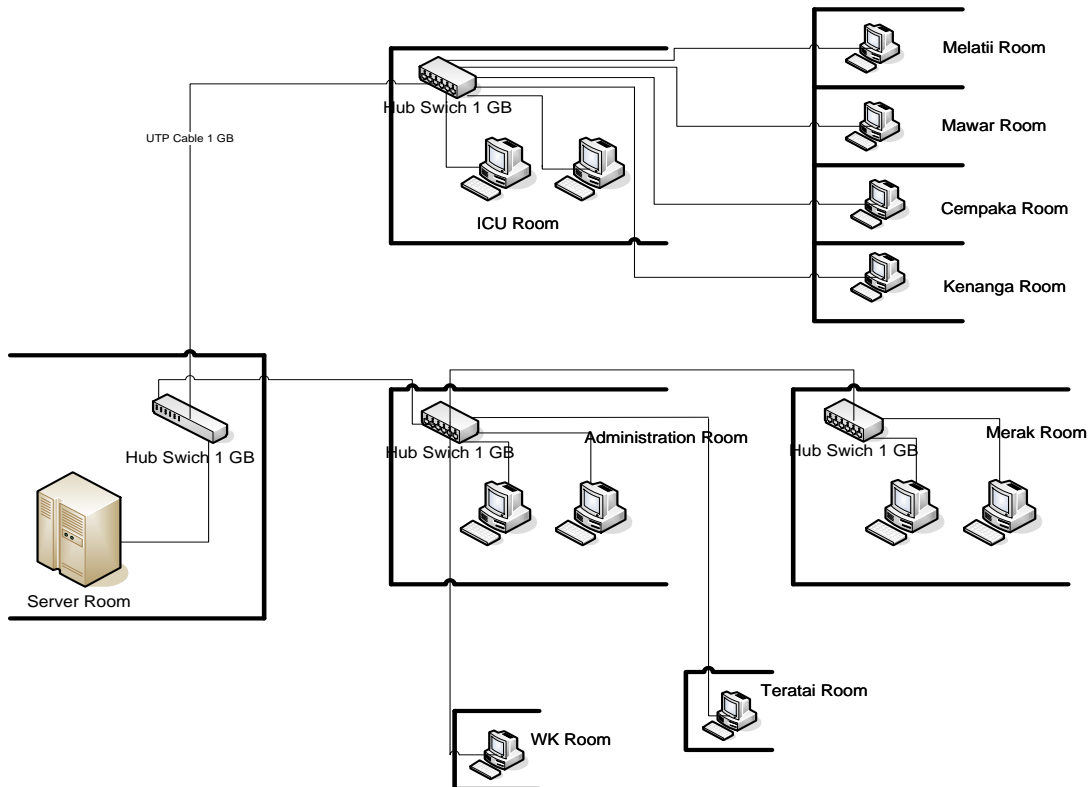


Figure 3. Network system and hardware infrastructures for inpatient

Table 1. Healthcare Knowledge Categories

Types	Levers	Knowledge
Structural Knowledge	Organizational Memory	<b>Rules and Procedures:</b> Medical Ethic and Law; General Treatment Procedures; Hospital Care Procedures
	Stakeholder Relationships	<b>Medical Infrastructure Guidance:</b> Treatment Tools; Laboratory and Radiology Tools <b>Stakeholder Overview:</b> Revenue Forecast; Pharmacy Paths and Consumes; Policies
	Knowledge in People	<b>Medical Theories:</b> Physiological Arts; Neurological Arts; Pathological Arts; Pharmacological Arts; Nursery and Gynecological Art <b>Syndromes and Diseases:</b> Causal and Symptoms; Infectious Issues and Epidemiology; Genetically Issues
	Customer Knowledge	<b>Patient Acknowledgement:</b> Patient Education and Empowerment; Patient Psychological Response; Patient Medical Inspection; Patient Safety and Alert; Patient Specific-Care Planning; Patient Monitoring <b>Customer Issues:</b> Healthcare Satisfaction; Customer Relationship Management
Functional Knowledge	Knowledge in Process	<b>Medical Case Analysis:</b> Medical Histories; General Case Analysis; Laboratory Report; Radiology Report; ISO / MIMS; Specific Case Analysis
		Medical Evaluation: Symptoms Description; Allergic Evaluation; Contra Indication Analysis; Medical Case Decision <b>Medication:</b> Symptoms or Causal Medication; Drug Prescription; Therapeutic Treatment; Specialized Medication
		<b>Medical Report and Standard:</b> General Case Report; Hospital Case Report; Medical Record Reconstruction; Doctor Conclusion Letter; Medical Practitioner Resume
Behavioral Knowledge	Knowledge in Products and Services	<b>Healthcare Intelligent:</b> Omset of Action Calculation; Nutrition Agent <b>Practitioner Learning:</b> Internal Meeting; Seminars and Workshops
	Business Environment Insights	<b>Care Team Collaboration:</b> Surgeries; Specific and Pandemic Case

Cultural analysis finds out the cultural models in the current organizational mechanisms and models of real culture are expected by the employee (medical practitioners) are in the organizational mechanisms that associated with the four categories of culture, namely: Clan, Market, Adhocracy, and Hierarchy. Where, this time at the PELNI Hospital more reflect the type of culture following the hierarchy culture that is more focused on internal issues rather than external issues and stability and control value than the flexibility and consideration. Meanwhile, for the future, PELNI Hospital more focused on internal issues in a flexible and forwards the consideration which in theory is a type of clan culture. This type of culture is in accordance with the needs of knowledge management culture because it emphasizes sharing aspects, especially in terms of knowledge.

The third stage of development of healthcare knowledge management (HKM) is performed the design process that contributed in three forms, namely: mapping of its knowledge resources as shown in Figure 5 with the relational model is done through the development of knowledge in the three-level topology where the domain as the main categories, region which is a sub-category of domains and section which is a sub category of regions that show the flow of access to knowledge in the PELNI Hospital database, as well as an analysis of the knowledge portal features that produce the main features of using the required field as a component in each of the features that must be filled in or selected by the user in full to be considered in knowledge database where from the feature, there are five features that support the creation of knowledge is MedDiscuss that creates knowledge from a combination of tacit knowledge from various medical practitioners in handling a case, Healthcase manage consumer issues as well as insertion with tacit knowledge of a medical practitioner so as to create a case-based knowledge, MedIdea organizing various opinions and alternative solutions from a variety of medical practitioners in completing medical problems that result in problem-based knowledge, MedLearning allows a number of medical practitioners to enter a variety of up-to-date learning materials which can be combined to generate learning based-knowledge and MedLibrary acquired a variety of files and medical knowledge of all activities that undertaken and to be

knowledge base repository on PELNI Hospital. Therefore, the knowledge management process for healthcare in hospital can be seen on Figure 4.

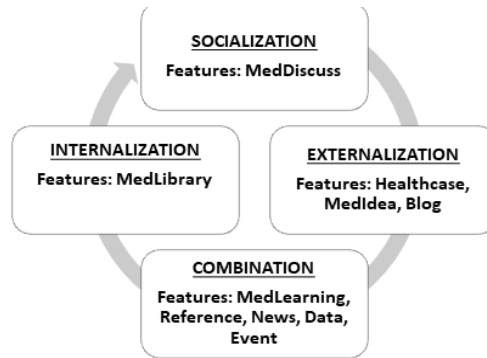


Figure 4. Knowledge management process for healthcare in hospital

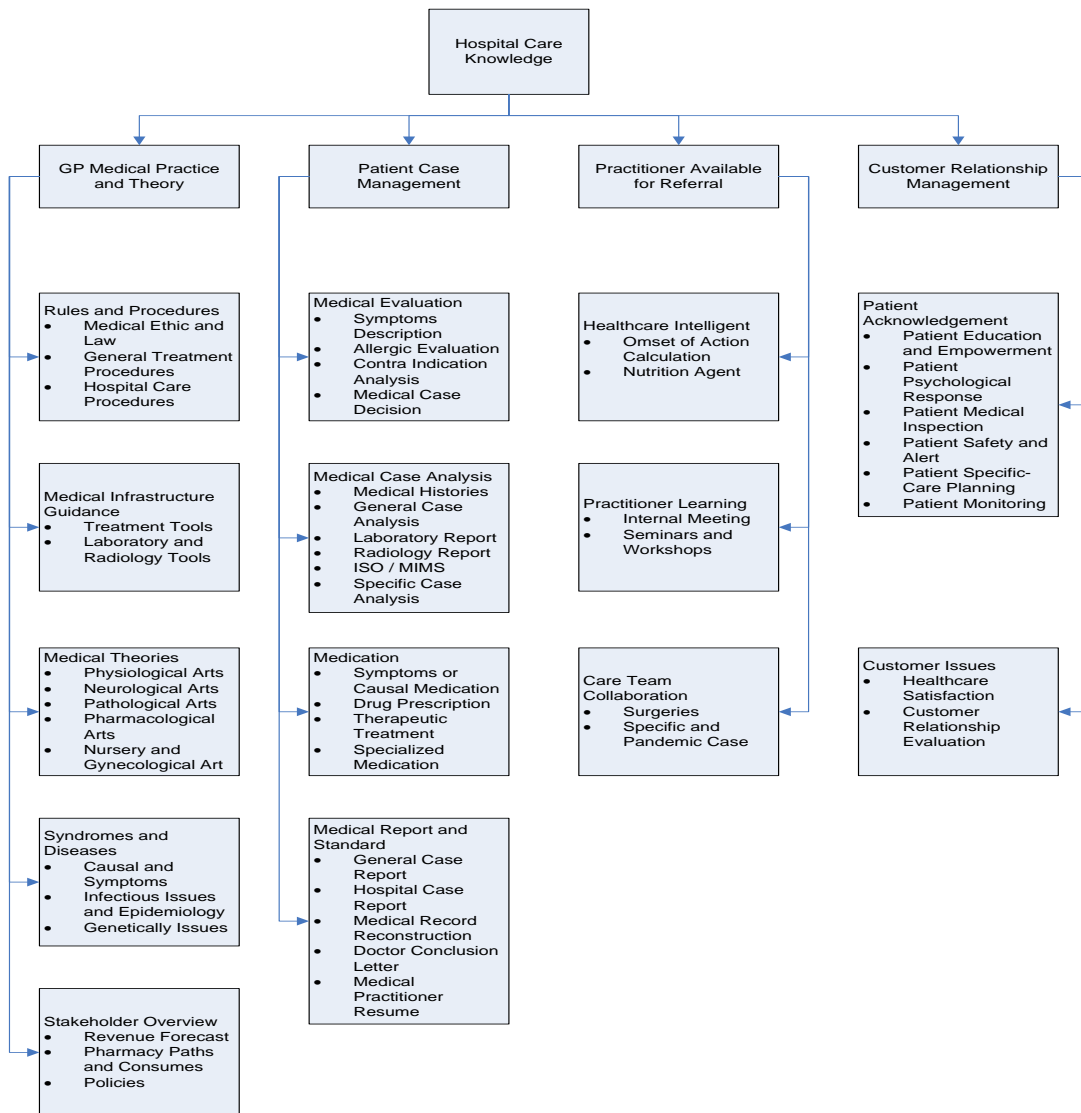


Figure 5. Mapping of healthcare knowledge management for PELNI hospital

The design of the system which describes the pattern of interaction between the user with the system through the development of web portal that will connect directly to the server PELNI Hospital using the Object-Oriented Analysis and Design with two models that is the logical model that describes the process of interaction in the portal activity as well as a description of the patterns of access and the process of communication between the portal and database PELNI Hospital that depicted in UML models consisting of class diagrams as shown in Figure 6, use case diagrams as shown in Figure 7 and sequence diagrams, while the development of a physical model using the user interface diagram as shown in Figure 8 the physical appearance of each feature in a knowledge portal and its interaction with user.

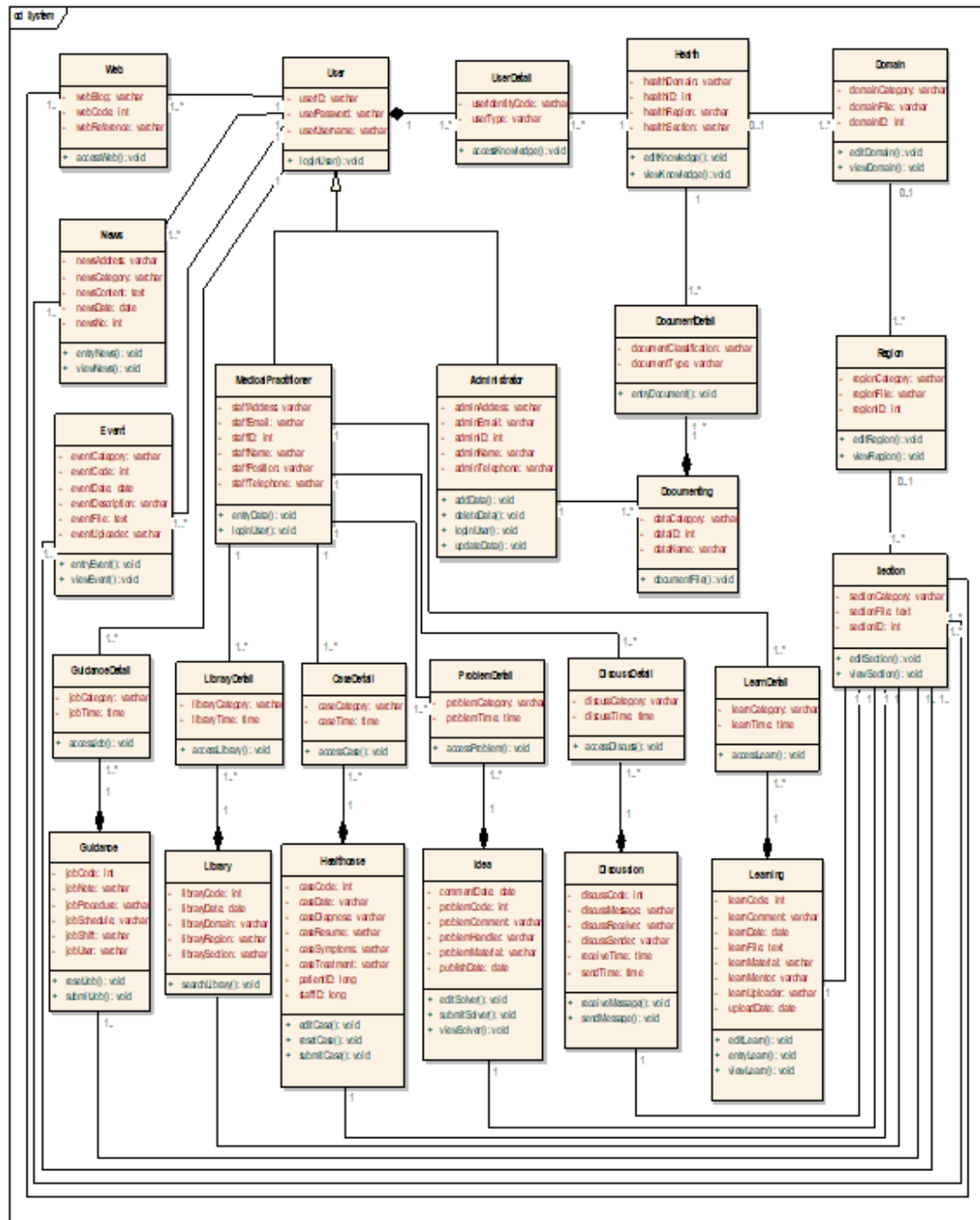


Figure 6. Logical model for class diagram knowledge portal of PELNI hospital



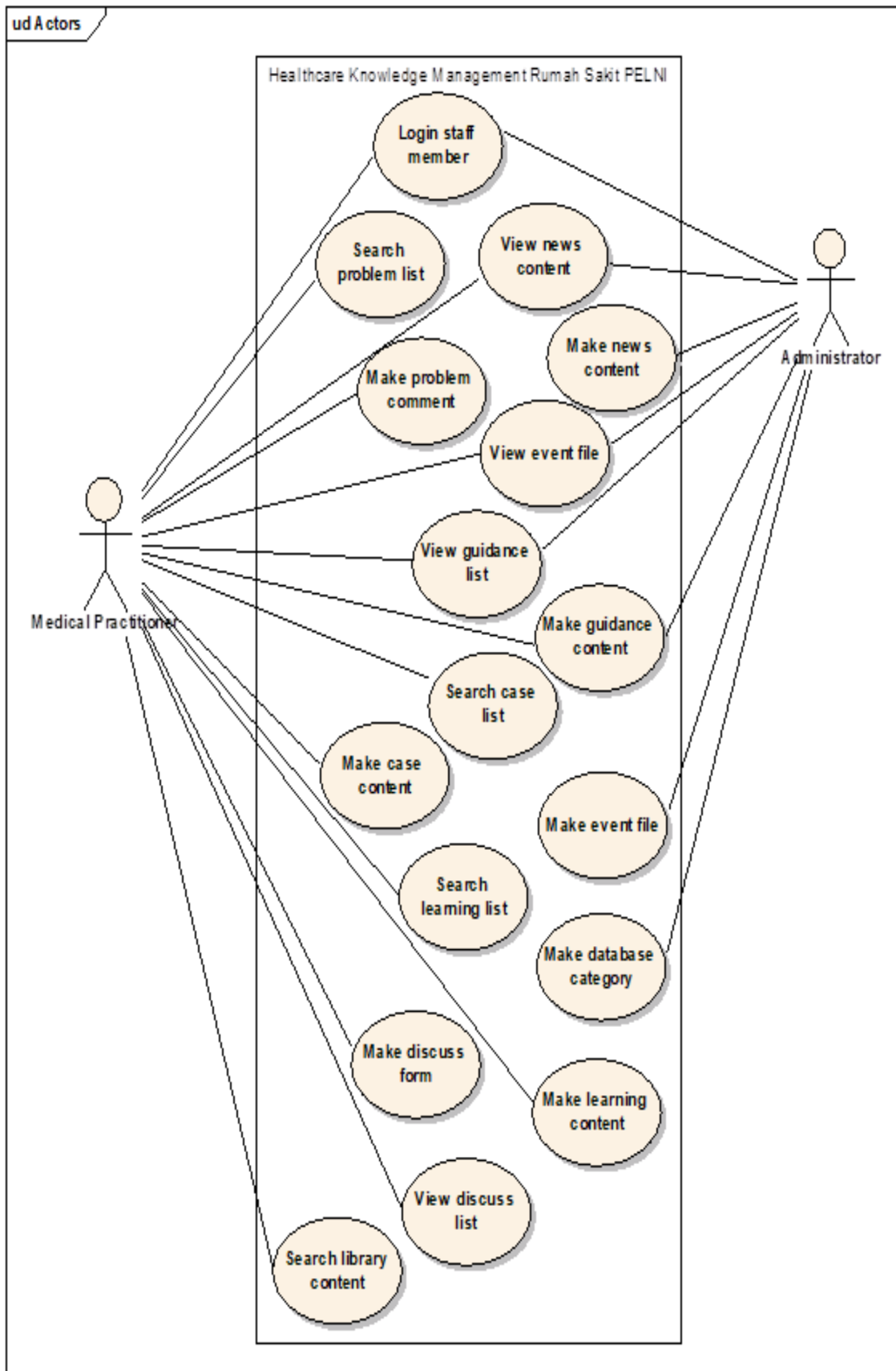


Figure 7. Use case diagram knowledge management portal

**My Note**

Date: 02/02/2012

Note: Penanganan pasien Glaucoma bangles Merak membunuh anastesi Lincocin 5 cc pada valve Mediana

Procedure / Guide

Section: Medical Ethic and Law

File: medical\_ethic.pdf

**Welcome to PELNI Hospital Knowledge Portal**

You Can Talk, Share and Make Your Own Knowledge

**My Point**

Your cases uploaded	2641
Problems comment	263
Grade	A

**Reference Specialist Blog**

dr. Haryono Winarto, SpOG  
 dr. Rizki Setyaningsih, SpA, MKes  
 dr. Hengky Setiadi, SpB, FNSAC  
 Prof. DR. dr. HD. Jusi, SpB, SpBY (K)  
 dr. Wicaksono, SpB, SpBTKV  
 dr. Firdausy Saleh, SpB, SpU (K)  
 Prof. DR. Erol, U.H. FICS, SpB, SpOT (K)  
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 dr. Arnold Simanjuntak, SpB, SpBD  
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 dr. H. M. Zaini, SpIP  
 dr. Sri Yustira Pratista Dewi, SpPro  
 dr. Asep Denny, SpAs  
 dr. Sunardi, SpPK (Konsultan)  
 dr. Yulia Rosa, SpOK  
 dr. Achiana Hendarti, SpRA  
 dr. Virinta F. SoEad  
 dr. Drah Eka A. M. Giri, SpOK  
 dr. Puji Lestari, S.Pai, M.Pai

**NEWS**

REVENUE OVERVIEW

Select a year: 2009

Hospital Revenue Graphic per Billion Rp/ 1h 2009

Year	Revenue
2009	12.6
2009	13.0
2009	17.0

**EVENT**

Select a year: 2009

medicine consumes per thousand (unit) Th 2009

Year	Consumes
2009	20.0
2009	22.0
2009	26.0

**CASES**

File	Submit by	Date	Description
Epilepsi Transnasal	dr. Arina	2012-02-02	Include causal, symptoms, diagnose, medication and surgery treatment
Chronic Gastroenteritis	dr. Mardi	2012-03-03	Complete diagnose for specified entero-treatment with Laparoscopy

**Web Reference**

Google, CDC, Medscape, BMJ, mims, PubMed

**Most Visited Categories :**

REGION	RANK
Medical Case Analysis	1
Medication	2
Rule and Procedures	3

**Last Access User :**

USER	FILE
dr. Haryono SpOG	neonatal.pdf
Arianti Ahd Kep S.Kep	case.pdf
dr. Sutji Hartati SpS	neurology.pdf

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Figure 8. User interface window index (KM main portal)

#### 4. Conclusion

From the results of the analysis and design of healthcare knowledge management portal in PELNI Hospital obtained the following conclusion. Where the analysis is done through the categorization of knowledge into seven level of knowledge that became the core resources in Inpatient and Outpatient Care medical activities of PELNI Hospital which produces fourteen (14) categories of healthcare knowledge resources that necessary by medical practitioners in optimizing time management in decision making and improving the quality of medical decisions. From the standpoint of distribution (sharing) of knowledge in PELNI Hospital medical institutions performed with the model of divisional shown from the company's organizational structure that is divided by divisions (one of them is Services and Marketing Division), which coordinates the medical activities of PELNI Hospital.

Mapping of the owned knowledge resource with the relational model is done through the development of knowledge in the three-level topology where the domain as the main categories, region which is a sub-category of domain and the section which is a sub category of region that show the flow of access for knowledge in PELNI Hospital database, and analysis the features of the knowledge portal that produce the main features that are Healthcare, MedDiscuss, MedIdea, MedLearning, MedLibrary, Data, News, Events, Guidance, Blog and Reference that are categorized using SECI model into four knowledge management activities.

Analysis and design stage in the development of PELNI Hospital knowledge portal is done in two models that are the logical model that described in UML models consisting of class diagrams, use case diagrams and sequence diagrams, while the development of a physical model using the user interface diagram.

## References

- [1] H Xu, O Musicant. Design and Implementation for Ontology Modeling of Design Knowledge Based on UML Class Diagram. *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, Sep. 2016; 14(3A): 326.
- [2] S Candra. ERP Implementation Success and Knowledge Capability. *Procedia-Social and Behavioral Sciences*. Dec. 2012; 65: 141–149.
- [3] J Gan, G Xie, Y Yan, W Liu. Heterogeneous Information Knowledge Construction Based on Ontology. *TELKOMNIKA (Telecommunication Computing Electronics and Control)*. Dec. 2016; 14(4); 1617.
- [4] T Oktavia, HLHS Warnars, S Adi. Integration Model of Knowledge Management and Social Media for Higher Education. *TELKOMNIKA (Telecommunication Computing Electronics and Control)*. 2017; 15(1): 101–108.
- [5] Tempo. Sampai Akhir 2012, Terjadi 182 Kasus Malpraktek. *Tempo News*, 2013. [Online]. Available: <https://m.tempo.co/read/news/2013/03/25/058469172/sampai-akhir-2012-terjadi-182-kasus-malpraktek>. [Accessed: 20-Jan-2017]
- [6] M Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy*, Corr. Ed edition. Chicago: University of Chicago Press, 1974.
- [7] JC Spender. Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal*. Dec. 1996; 17: 45–62.
- [8] RM Grant. Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*. Dec. 1996; 17: 109–122.
- [9] TH Davenport, L Prusak. *Working knowledge: how organizations manage what they know*. Ubiquity, vol. 2000, no. August, p. 2, 2000.
- [10] I Nonaka, H Takeuchi, *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press, USA, 1995.
- [11] I Nonaka, K Umemoto, D Senoo. From information processing to knowledge creation: A Paradigm shift in business management. *Technology in Society*. 1996; 18(2): 203–218.
- [12] M Alavi, DE Leidner. Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *MIS Quarterly*. Mar. 2001; 25(1): 107–136.
- [13] B Bergeron, *Essentials of Knowledge Management*. John Wiley & Sons, 2003 [Online]. Available: <http://as.wiley.com/WileyCDA/WileyTitle/productCd-0471281131.html>. [Accessed: 05-May-2017]
- [14] RK Rainer, B Prince, HJ Watson, *Management Information Systems*, 3 edition. Wiley, 2014.
- [15] SSR Abidi. Healthcare knowledge management: The art of the possible. in *Knowledge management for health care procedures*, Springer, 2008, pp. 1–20 [Online]. Available: [http://link.springer.com/chapter/10.1007/978-3-540-78624-5\\_1](http://link.springer.com/chapter/10.1007/978-3-540-78624-5_1). [Accessed: 20-Jan-2017]
- [16] JC Wyatt. Management of explicit and tacit knowledge. *Journal of the Royal Society of Medicine*. 2001; 94(1): 6–9.
- [17] S Bennett, R Farmer, *Object-Oriented Systems Analysis and Design Using UML*, 4th Revised ed. edition. Maidenhead, Berkshire: McGraw-Hill Education, 2010.