

## The impact of PACS (Picture Archiving and Communication System) for M-learning on the medical affairs

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**ABSTRACT:** PACS (Picture Archiving and Communication System) is one kind of M-learning. It is a common imaging method utilized in many Taiwanese hospitals for providing update medical service at this moment. Lots of articles concerning the benefits of this system have been reported. But less articles are clearly pointed out the impact of PACS on the change of medical affairs about education, treatment, research and service. We develop an unstructured interview study with the PACS familiar representatives in general hospitals by an interview schedule. We found that the PACS will affect on several dimensions concerning the medical ethics, medical training, safety/ security of patients, transfer system, communal care and style of management in a general teaching hospital.

**Keywords:** PACS, education, treatment, teaching hospital

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### 1 Introduction

Mobile or remote learning brings a lot of change inside the medical faculty and the medical enterprise. The abruptest change is about the medical ethics, training methods and imaging analysis. These impacts deeply affect the qualities of the medical manpower, diagnosis and therapeutics forth to the patients. So, insurance and legal problems will invariably be expected to appear. PACS (picture archiving and communication systems) is one kind of M-learning strategy. It provides medical treatment organizations a convenience on imaging storage, reformation, easy copying and fast transfer. In this report we want to clarify its impact on a local district hospital, whose roles are the first station to face the society, trigger the medical transfer

system and nourish the medical professionals. We want to analyse the effects of the PACS bringing to a general teaching hospital. We focus on the change of certain medical affairs along the patient, doctor, community and the hospital administration.

### 2 Background and Purpose

PACS has been used worldwide in recent decade. The adoption of PACS in Taiwan hospitals has been quickly increasing from 11 hospitals in 2000 year to 44 hospitals in 2003 year[1] and even hundred percentages of our center hospitals. Its significance in film-less policy, cost saving[2] and workflow enhancement[3] has drawn a lot of attention from many hospital investors and radiologists. Besides, evidence base medicine has

showed that the accuracy of post-PACS diagnosis was improved in pediatric emergency department [4, 5]. Recently, academic articles concerning the PACS infrastructures such as the instrumentation success[6], interoperated interfaces and standardization systems[7] have been reported. The topics of cost-benefit[8] and healthcare enterprise [9] have also been reported. Studies in different fields from the narrow angle of medical health care, commercial technological industry broaden to the government policy. But, fewer studies described the whole impact items and their strength on the medical affairs[10]. So, we want to design a study to realize what impact is in a general hospital whose mission is education, treatment, research and service.

### 3 Literature Review

#### 3.1 What is PACS?

The idea of PACS was developed from 1980. It includes three major components; image, transfer and storage systems. Huang[11] defined PACS composing the elements of image acquisition; retrieval and productivity with administrative storage systems through computerized instruments and integrated network platform.

It was initially used in medical services of remote areas and later in the health enterprise. Recently, its technology has been well established and matured. Investigators put it in the IHE (integration of health enterprise) with aim of personal medical continuity through the linkage of medical specialties, integration technologists, computer industry and vendors of health management systems through the international established communication standards such as HL-7 ( Health Level Seven), DICOM (Digital Imaging & Communication in Medicine) or ISO (international Organization for Standardization) [12].

#### 3.2 Conventional X-ray against PACS

In the old image era, patient spent more time waiting for film develop and transfer. Sometimes, the patient needed more exposure to X-ray due to poor quality of a film. Furthermore, the institutes employed a lot of manpower to transfer the films, coding the films, stored the films and checking the lost films. On the contrary, PACS gave the medical treatment organizations a film-less environment, cost-effective investment[2], lesser

pollution and space saving benefits. The other comparisons are reviewed in the table 1[13].

#### 3.3 PACS in M-learning

E-learning is accomplished over the internet, a computer network, via CD-ROM, interactive TV, satellite broadcast, or even a mobile phone[14]. Many educational modes[15] could be applied in e-learning, such as the tutorial strategy in web course and the simulation method in the 3-D flight training. When combined with PACS, which solving the spatial-oriented problem, many difficult anatomical lessons[16] become easier to be learned. Such integration of medical image and e-learning creates a new era of telemedicine [17] which conduct better personal health knowledge management, and professional training. Also, their linkage to interfaces have been developed to increase the capacities of M-learning[18]. Such as the PACS which provides a visual capability and delicate demonstration for the illness and the health.

#### 3.4 Problems in PACS

Within these two decades, PACS has nearly glowed to mature in world wide. In Taiwan, the integration of different platforms such as RIF, HIS Table 1. Comparisons of the conventional image method and PACS[13]:

	Conventional X-ray	PACS
<b>New instrumentation and software investment</b>	No need	Cost in the new setup and upgrade projects
<b>Hardware calibration</b>	Need	Need
<b>Technician training</b>	General	Informatist and users training, need good communication with the vendor
<b>HIS/RIS integration and workflow</b>	Wasting manpower and time for coding, develop and transfer of films	Computerization, but system turnover and film implement time wasting
<b>Image accessibility</b>	Only the holding reader	Any time, any place, multi-reader simultaneously
<b>Loss of film</b>	Easy	Lesser
<b>Compared with the old images</b>	Must get all the films at the same time,	Easily pointing out images at different time
<b>Film disintegration</b>	easy	Never
<b>Storage space</b>	Large	small

<b>Loaning and storage interplead</b>	Limited to opening hours, and spending time in hospital travelling	Digitalization and automated, but need monitor and screen
<b>Transfer to other hospital</b>	Need copying the films	Through hospital internet and standardization platform

and PACS has been solving[19]. The remaining PACS problem is the interoperated agreement and standard[1]. Also, the Chinese word Unicode which is different from the conventional DICOM should be notified by the Asian users.

## 4 Research Design

### 4.1 Process and approach method

We perform the study in several steps. (1) First step: Use goal oriented strategy to choose Ten-Chan and Ten-Chen general hospitals these two teaching hospitals as our study field since they have the same goals of this study; thus, education, treatment, research and provided communal service. (2) Second step: Use Secondary research method collecting the information from the Medline and PubMed web site citing the words ‘PACS’ (picture archiving and communication system) linked with the terms education, treatment, research and service respectively. (3) Third step: Choose ten PACS familiar representatives; each five from different hospital; two PACS related doctors from the two different hospitals, two imaging department technician chief, two hospital investigators, two hospital chiefs, two informatics technicians (4) Fourth step: Read all cited articles and redact an 9-question interview schedule shown in Appendix 1. (5) Fifth step: Arrange semi-structure interview by face-to-face method with the representatives individually and deeply discuss the contents of the schedule. (6) Last step: Content analysis technique use in analyzing the text or data from interview. Collect their opinions and conclude different dimensions for writing this paper. In each dimension, we draw out the important spirits and try to become subtitles (shown in green blocked italics in this paper) for preparing a semi-structure questionnaire in the next paper.

### 4.2 Sampling Strategy

We used quota sampling to date the radiologists in different hospitals and began a general face-to-face interview for seeking the other 8 cases with his/her our will by the snowball method.

## 5 Discussion

### 5.1 Impact of PACS in medical affairs

#### 5.1.1 Medical ethics

The common ethical challenges in e-learning are *privacy invasion* and *uniformity of access* (sufficient skill to handle the hardware and software during the e-learning). The other topics are *language barriers* ( eg. multiple redundant delivery mode or instrumentation), *non-biased or honest transfer, informal* or previously invisible *data capture* (unpleasant illustration or anguish comments during the videoconferencing )[20]. They are psychosocial matters and depended on the users’ manner. The providers and users should *pay more responsibilities, honesty* to them[21].

As we mention that PACS is one kind of mobile learning. Thus, PACS is inherent to carry the ethical issues that happened in the e-learning. Although this part in medical affairs is lessly reported[20, 21], it was surprisingly mentioned by six of our informants in our depth interview. Two of them are radiologists, one is neurosurgeon, and one is neurology. The remained two are chief of the hospitals. The topic may be related to a recent big medical news happened here. In Taiwan, a big news about no vacancy and transfer of a subdural hematoma child and later she got death due to the delayed operation. The neurosurgeon claimed that he had no need to arrive in the emergency department as he had used PACS to review the image. *Overdependence of PACS* by doctor might create an immoral doctor-patient relationship. One of the informant concluded ‘admittedly, this dangerous manner and lazy medical behavior gave a wrong treatment and directly threatened the safety of the patient.’

#### 5.1.2 Medical training

In medical training, all the informants agree that e-learning provides an *anytime, anyone and any place learning environment*. It may conduct several methods with the help of PACS. The most attractive is the *bisynchronous realistic remote* teaching in the desktop videoconferencing. For example, the cardiologist could demonstrate the whole coronary artery intervention process in a catheterization room and the students could discuss and ask questions outside inside the hall. The second is signed in web course or teaching files (8)which the interns or residents can *autonomously* select a course(Video-on-demand) according to his or her ability(*suitability*) in anywhere or anytime to fulfill the basic

knowledge to go on further study step by step. The internet can also provide a virtual class such as the chartroom or Bulletin Board System for the discussion of a real patient. Or within the animated adjunct case-study, the medical students can develop a **logical sequential thinking process** for the treatment of a real patient.

Seven informants criticize that PACS is not so satisfactory at this moment. This opinion is compatible to Seigel [22] who pointed out that the setup of teaching file was more inconvenient than the conventional unite person power point show. It must be established by a team of partners such as the informatists, radiologists, technologist, users and even the vendors under an audit or several conferences. It is **time wasting** and **inherently limit the expansibility** of PACS M-learning.

Concerning about the career change of physicians, the two radiologists highly emphasize the following points. The integration of different platforms and management of the knowledge with PACS will make the radiologist to become informatics specialists[23] and **elicit a new type of medical consultation** [24, 25]. The **daily work practice of radiologist and non-radiologist** are also changed. Doctors note that the radiologists may be faster to give a report. And the doctors prefer the daily combined meeting to be abolished as they realize that the PACS can provide an earlier discussion between them. Those are matched with the Aas's recent articles; 21% of the responders wanted to abolish some conference [26].

### 5.1.3 Safety/ security of patient

The confrontation problem of safety and security is a hot title to be discussed. Diverse opinions are drawn. PACS can improve the **accuracy of the clinical diagnosis** as multiple or different sites physicians can simultaneously read the images at the same moment under a logged virtual network. Furthermore, physicians can manipulate or zoom the concerned images. The digital images are less likely to be lost or misplaced as well. So, the **legacy** of the patient and the **change of consecutive images** in the electric medical record can provide long and can be easily accessed in different places. For example, a local district doctor can easy save a sudden consciousness loss patient if he knows the patient having epilepsy and frontal lobotomy history from his identity card. The families also easy catch the "**anatomy**" concept or the orientation of an internal organ when the doctor describes the problem quickly in this urgent condition. This **time-saving and avoidance of misleading** issues are especially

important in the emergency or intensive care department. Perhaps, even the daily routine life of a doctor and the **doctor-patient relationship are improved** by this system.

However, the PACS may have some inherent traps need further attention. If the doctor gave a wrong interpretation in the web, there will be hard to correct since the network spreads far in anywhere, anytime and anyone. So, the doctor should **take more alertness and responsibility** before he posts his opinion in the platform. The two radiologists realize that they will give more rule-out in the impression since they find that many PACS image are good to show the early lesions!

### 5.1.4 Transfer system

The health promotion doctor commends that after the **shorten of turnover rate**, the **referring doctors play a more important role** in the community since they discuss the imaging diagnosis with the patient in the clinics. As the integration of RIS/PACS and web-site access, it strengthens the linkage between the primary and the tertiary health care systems[27]. The referring communal physicians and the center radiologist can discuss the patient simultaneously. This **two-way communication creates not only a more precise diagnosis** but also establish the mutual credits between them. Inter-organization plans such as the PoMHIS providing personal **EMR will simultaneously change the medical environment** and administration on the general hospitals as they must join in centre hospital for further care of a client.

### 5.1.5 Impact on the communal care

The **knowledge awareness** of the sick has been increasing in this twentieth SARS century. It is important to introduce the **concept of personal or individualized health care and promotion** to the patient as the WHO emphasize. M-learning provides an anytime, and anywhere expediency to anyone to access this aim. Also, it can **condense many preventive medical knowledge**, disease symptomatology, epidemic information, transfer system of different medical treatment organization for the community residents. In this field, PACS acts an important role for drugs identification from the drugs website ( eg. **Illustration** of the ant-epileptic agents), case presentation ( eg. Lung cancer) and somehow, even the introduction of new diagnostic methodology ( eg. brain tumor by PET).

### 5.1.6 Change in the hospital management

Cost-benefits is the main topic of hospital management. The investors will outbalance[28]

the cost among the consideration of financial resources, peripheral advantages, film-less economy, uncountable retrieval, infinitive storage against the image acquisition, upgrade service and customer training. They will be enforced to *learn a new strategy to centralize or integrate* the professionals and the administrators. Thus, rigid standardized whole scale PACS will be given up by the capitalist and they will fit the demand of users with basic requirement under strategy of the so call "*Request for Proposal*"[29]. Obviously, the vendors and consultants will play an important role for the implementation and selection. Therefore, the investors cannot keep their dominant administration. Instead, their decision making will be shifted to a *professional-guided teamwork style*. Thus, their power will be challenged or *decentralized to the infrastructure of the team*.

### 5.1.7 Others

During the interview, five of the doctors realize that the IHE is critically important in Taiwan. All of them business and politics affect a lot. It was the comments from the report of Lian[30] but seven informants think the difficulties in Taiwan IHE will soon be overcome.

The two informatics technicians and three clinical doctors mention that there are still other non-medical illegal problems creating by PACS and the medical enterprise absolutely dare to face: 1) Image copying to a compact disc for patient may include an illegal piratic software transfer. 2) Global budget of Taiwan cannot afford the instrumentation fee for the integration of different inter-hospital's platforms. And lack of trust is the main obstacle of the integration healthcare enterprise.

## 6 Conclusion

From this study, we collected and analyzed the interviewers' pearl opinions. Six dimensions of medical issues are conducted to be influenced by the PACS. They are medical ethics and training, patient safety/security, transfer system, communal care and management style. Each of them can bring out several important subtitles. The comments of the ten professionals are well matched the ideas of the literatures. And some outstanding points such as the medical ethics and overdependence of PACS are emphasized as they are against the PACS development.

We will use these 6 dimensions and the subtitles to assign another study and develop a semi-structure questionnaire in the fore coming.

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## Appendix

### Appendix (1) Questions discussed in the meeting of different representatives

PACS ( picture archiving and communication system) is a method or interface to put the image in digitalization and use computer to present a good image. Then it can be wild use in clinical affairs.
1> What is/are the influence of PACS in medical training ?
2> What is/are the importance of PACS in clinical usage?
3> What changes the PACS brings in the patient security/ safety of the patient?
4> What will you consider about the PACS in hospital management?
5> What is/are impact of PACS on the communal change?
6> What is/are the disadvantages of PACS?
7> What is/are the advantages of PACS?
8> What is/are the impact on the medical ethics challenging by the PACS?
9> What other impacts the PACS will give in a general hospital ?