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E-Health in the Nordic Region

In Europe, medicine is moving from a provider-centric to a patient-centric environment and, in order to do that, infrastructure must aggregate large volumes of data across time and space. A health service that puts the patient at the centre of a network of providers increases the sector's dependence on information. Such a model presumes access to and availability of a patient's medical information independent of time and place. The creation of multispecialty, multisite archives for medical images will further drive a multidisciplinary approach that will promote enhanced patient-centric healthcare. This patient-centric view is also being driven by the availability of information throughout the hospital, enterprise and beyond; as regional health information systems become commonplace, radiologists will search for prior studies throughout the region, maybe even the country.

Regional PACS in Europe

The current European scenario is a bit different from the other (mainly North American) global markets and there are a number of issues to be addressed when it comes to PACS installations. The major factor affecting the market is the unaffordable price of the PACS systems and the fact that, being a substantially public healthcare system, governments do not encourage new technology with ease. Different geographies face different kinds of challenges. On one hand, countries such as the United Kingdom, have run national programmes for PACS installations, and on the other hand the northern European regions are fully saturated and entering the replacement market. There is a lack of understanding of the importance of efficient imaging systems and the storage of their outputs, but standardisation of these systems across the world in terms of usage, applications and quality is expected to play a major role in the development of the field.

PACS at Saturation Point?

A few peculiarities of the Nordic region allow us to understand the development of PACS technology within Scandinavia: a low population density, large geographical areas and non-ideal environmental conditions. Taken as a whole, they represent a bigger issue for healthcare delivery. In these countries, healthcare authorities have always looked at digital technologies as a solution to overcome the above problems. As a consequence, Scandinavian countries have been early adopters of PACS and as a result, the PACS market is completely saturated. Scandinavia, which is advanced in its PACS saturation in both software and services, is now entering the replacement market and looking for investments in post-processing modules, which would add functionalities within the widespread and existing radiology PACS infrastructure. Scandinavia represents Sweden, Norway, Finland and Denmark, and has the highest average PACS penetration rates in Europe. Almost 95 percent of hospitals, notably in Sweden and Norway, use PACS applications. Denmark is 90 percent saturated currently. During the next five years, the total non-radiology PACS market inclusive of ortho-, mammo, surgical and others in Scandinavia is estimated to grow at a compounded annual growth rate (CAGR) of 4.6 percent.

Healthcare in Finland

The Finnish public healthcare system is largely the responsibility of its 452 municipalities. In Finland there are five university hospitals financed in a similar way to ordinary hospitals, but that receive extra state subsidies, based on the number of specialists employed and the level of research undertaken. The role of the state government is largely supervisory and regulatory. Finland has one of the highest beds-to-population rates in western Europe at 8.3 per 1,000 as a result of the geographic remoteness of some of its regions. For the sake of comparison, the beds-to-population rate in France is around seven, in Italy is around four, in Germany is around eight and in the UK is around four.

The E-health Network in Finland

The large distances between population centres makes Finland ideally suited to the introduction of telemedicine. The country has embarked on an ambitious project to make the entire healthcare system digital and has pioneered one of the largest PACS installations in the world, initially with a network of 17 hospitals. An efficient network for transferring images provided the infrastructure for integration of different distributed imaging systems and enabled efficient handling of all patient-related information on one display station. Because of the need for high-speed communications and the massive amount of image data transferred in radiology, ATM (155 Mbit/s) was chosen to be the main technology used. Both hardware and software redundancy of the system have been carefully planned. The size of the DICOM image library in 2000 was 1.2 TB with 300 GB RAID capacity. For the increasing amount of teleradiologic consultations, a special DICOM gateway has been planned. It allows a centralised and resilient handling and routing of received images around the hospital.

The Finnish PACS initiatives continued in the following 2000 - 2004 period with HUSpacs (Hospital district of Helsinki and Uusimaa), one of the largest PACS projects in the world, producing 20 terabytes of image information and close to one million examinations per year. HUSpacs has a common database for 21 hospitals in the hospital district of Helsinki and Uusimaa. The goal of the regional HUSpacs has been to ensure seamless radiological service in specialty and primary healthcare in the HUS area. Exams are archived electronically to a regional image archive and are viewable, with the patient's permission, securely via the network in any hospital or healthcare centre.

Availability a Key Priority

HUSpacs ensures the availability and low cost of imaging services offered to 32 communities in the hospital district. In the HUS area an architecture that combines centralised and decentralised features is applied. The region has one network archive, which covers long-term storing and backup copying of images. Each hospital group has its own local RAID's as a short-term online archive. The capacity of the Fault-Tolerant RAID's is sized to store one to two years of image material. RIS/PACS integration has been accomplished using HL7-standards.

There is one common image database in the HUS area, divided for images of different organisations. It can be used to view images from the

whole service chain. HUSpacs also contains exams ordered from HUS by primary healthcare. Among the main advantages this project brought to the various stakeholders, are less moving and transferring of patients, fluency of care chains and better quality of care, simultaneous processing possibilities of images that enabled interactive consultations, lower cost of x-ray examinations and lower loaning fees.

Norway's E-health Network

Norway has extensive health services and a well-developed social security net. Each year Norway spends NOK 50 billion (around six billion euros) on hospitals, making it one of the European countries with the highest level of public spending on health per capita. About 35 percent of the state's yearly budget, or seven percent of the GDP, is spent on the Norwegian health and social welfare system. Norwegian health policy is centred on a publicly run health service available to the population, and the private sector, therefore, remains relatively small. The healthcare network is divided into three levels: national, county and municipal. The role of the state is primarily to devise national health policy, to prepare and oversee legislation and to allocate funding, while the counties and municipalities provide services. The country's five health regions have a regional hospital, each of which is a university-level teaching hospital. All the 19 counties have one county hospital and several district hospitals. In addition, there are a few state hospitals for nationwide service.

Health IT in Norway

Information technology has been integrated into the Norwegian health system to a considerable extent. Networked PACS solutions have emerged as a trend in the country. Investment in IT and making broadband available throughout the country is part of the government's E-Norway plan, which has established ambitious goals for IT development within both the private and public sector.

Electronic interaction is an important part of the health reform. The national health network has provided a good foundation for electronic interaction and information exchange in the health sector. National funding has been provided for the development of different services, standards and security guidelines as well as investment in broadband. Most hospitals in the country have already digitalised x-ray divisions, procuring equipment and systems for digital storing and communication of x-ray images.

Integration is a key requirement for all PACS in Norway. PACS has to be integrated with the RIS and the RIS has to be integrated with the HIS. Initially PACS was a departmental unit but nowadays it is a part of an enterprise system. The role of RIS and PACS within the hospital has evolved, and during the last few years has moved towards full integration with PACS: medical images have to be on-line 24 hours a day, discussions about archiving strategy and performance - with details about image retrieval times, disaster recovery, integration of images and text and selection of storage media - are going on.

Offsite archiving has been introduced and ASP models have been used by some hospitals and private imaging centres. Some regions in Norway have implemented PACS as a regional solution for all health enterprises within the region. In such a regional system one solution is that the health enterprises share a physical storage unit for the PACS (and RIS) information. The hospitals in Norway have chosen different solutions for RIS and PACS. Although all image communication uses the DICOM standard, information exchange does not seem to work seamlessly between hospitals.

In Conclusion

In Europe, the main challenge with full e-health implementation has been standardisation, harmonisation and integration. Some countries have succeeded in implementing seamless nationwide PACS systems, a key component of a national and fully electronic system, while some have not succeeded in avoiding having isolated 'islands' of unconnected PACS systems, thereby leaving the dream of a nationwide, interoperable Electronic Health Record (EHR) for each patient unfulfilled.

For the Nordic regions, who are advanced in their PACS implementations, and where the market is almost fully saturated, all regional health enterprises are obliged to exchange RIS/PACS information and the entire hospital must communicate both on a PACS to PACS and a RIS to RIS level. This high standard can be a model for countries still in the implementation stage, such as Italy. The challenge for the near future will be on the work on IHE and the use of the national health network to get the best RIS/PACS solutions for all hospitals.

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