

**Picture Archiving
and Communication Systems:
A 2000-2008 Study**

Research provided by
**The Dorenfest Institute for Health Information,
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Chicago, Illinois**



Contents

Introduction.....	3
PACS Installations.....	4
Vendor Market Share.....	8
PACS Image Distribution.....	10
Summary.....	13
About The Dorenfest Institute.....	14
About the HIMSS Foundation.....	14

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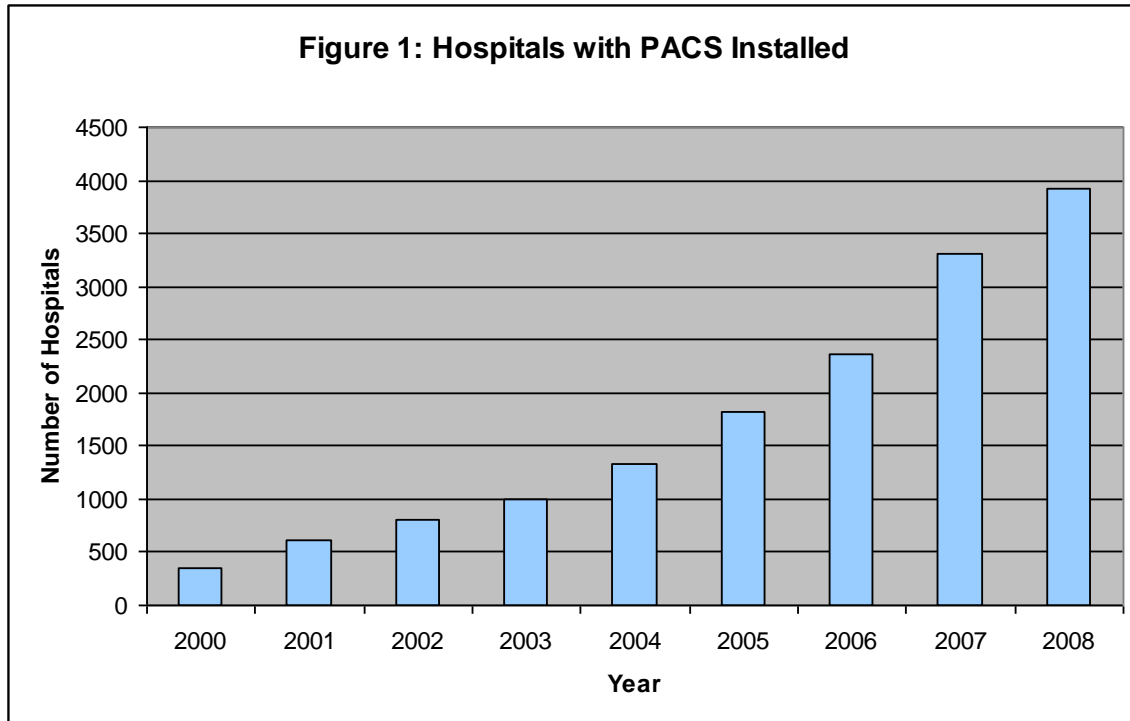
Introduction

This white paper explores the decade of PACS technology, its changes, growth in numbers of vendors supplying PACS, and installations in hospitals throughout the United States. PACS, the common acronym describing *picture archiving and communication system*, is comprised of computers and servers that are dedicated to the storage, retrieval, distribution and presentation of digital images. With digital image technology, PACS removes the historic barriers of radiology: the film-based images display and storage. PACS consists of image application algorithms for the manipulation and management of all radiologic images. Electronic images and reports are transmitted digitally via PACS; this eliminates the need to manually file, retrieve or transport film jackets. By digitizing images, hospitals have been able to reduce costs in film management and storage processes.

The information contained in this white paper was gathered using statistics found in the HIMSS Analytics™ Database. The database, derived from the Dorenfest IHDS+ Database, acquired by HIMSS in 2004, became the HIMSS Analytics Database. Healthcare systems in the United States self-report the technology used at their hospitals to create the HIMSS Analytics Database.

The Dorenfest IHDS+ Database began collecting PACS information from hospitals and vendors in the year 2000. After the initial year of collection of PACS information, only 8.2 percent of hospitals reported PACS technology installed. In 2008, the number of hospitals reporting the use of PACS technology in the HIMSS Analytics Database was 76.0 percent. As PACS became more widely used in radiology departments nationwide due to a quick payback from film replacement costs and more affordable commercially, different-sized hospitals began to utilize the technology.

In 2000, 342 hospitals nationwide reported at least one modality of PACS in use at their facility. By the end of 2008, the number of hospitals with at least one modality of PACS had increased to 3,928 as represented in Figure 1.

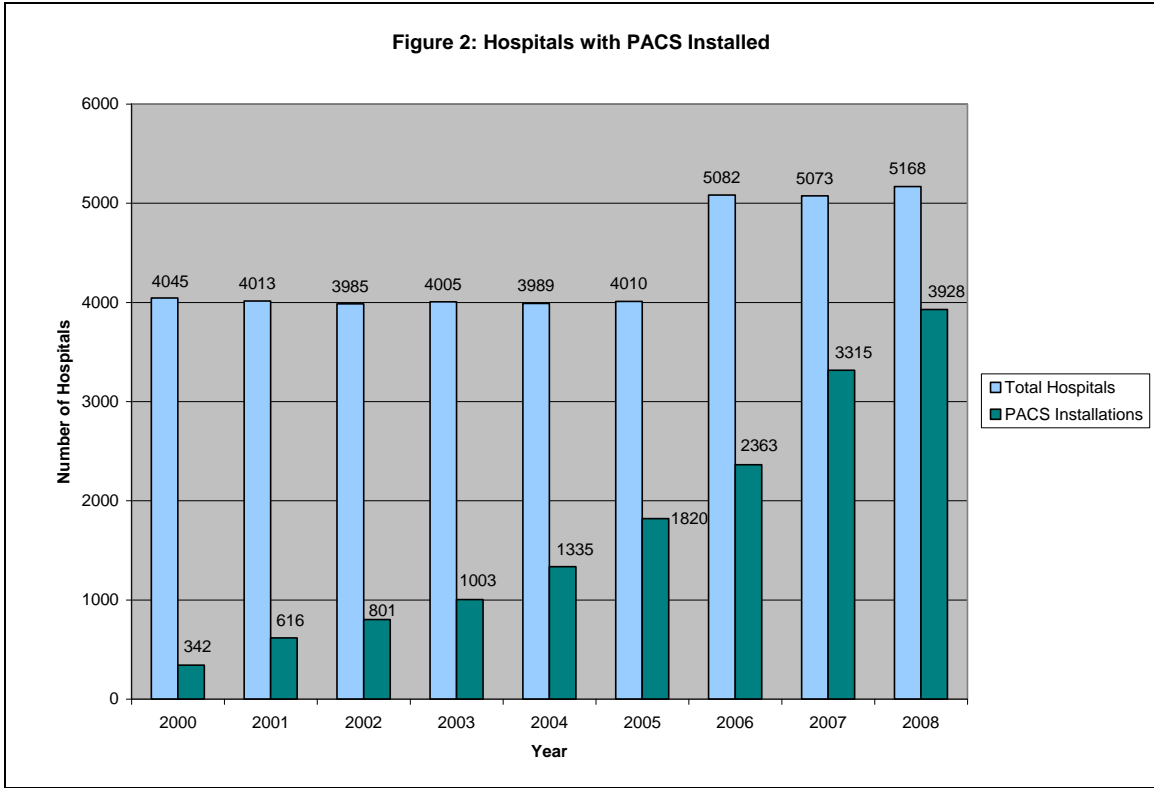


The vendors providing PACS technology to the healthcare industry almost doubled between 2003 and 2008. Fujifilm became the first fully Web-based PACS system, setting a trend for other vendors to follow. In 2003, 39 vendors were reported as having installations in U.S. hospitals. In 2007 and 2008, the number of vendors supplying PACS was 67.

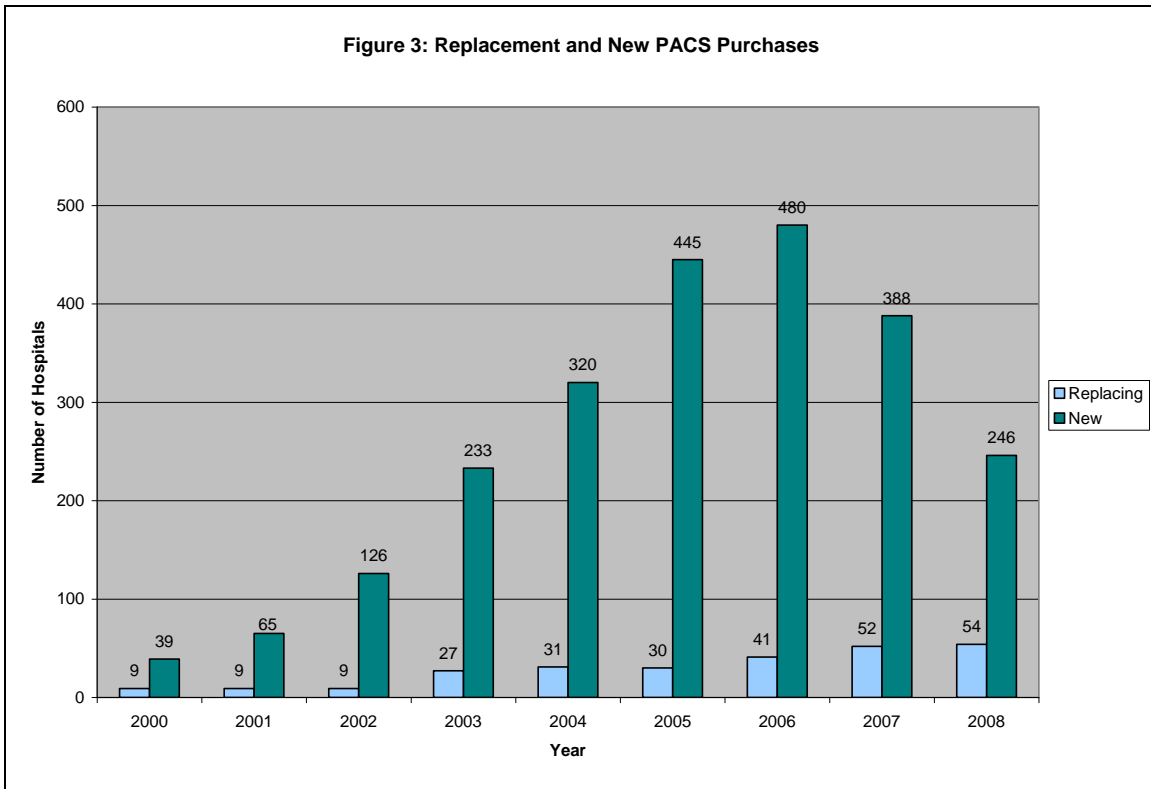
As the PACS market has evolved since 2000, HIMSS Analytics has also collected additional information about a hospital's PACS environment. Dorenfest began to gather PACS installation information as eight different PACS modalities in 2003. In 2005, questions about how PACS images are distributed within and outside the hospital were also added to the HIMSS Analytics Database.

PACS Installations

In 2000, 8.5 percent of hospitals indicated that they had PACS software installed. Figure 2 represents the number of hospitals that reported installed PACS software in relation to the total number of hospitals in the database. In 2008, 3,928 hospitals out of 5,168 hospitals, or 76.0 percent, indicated that PACS was live in at least one modality.

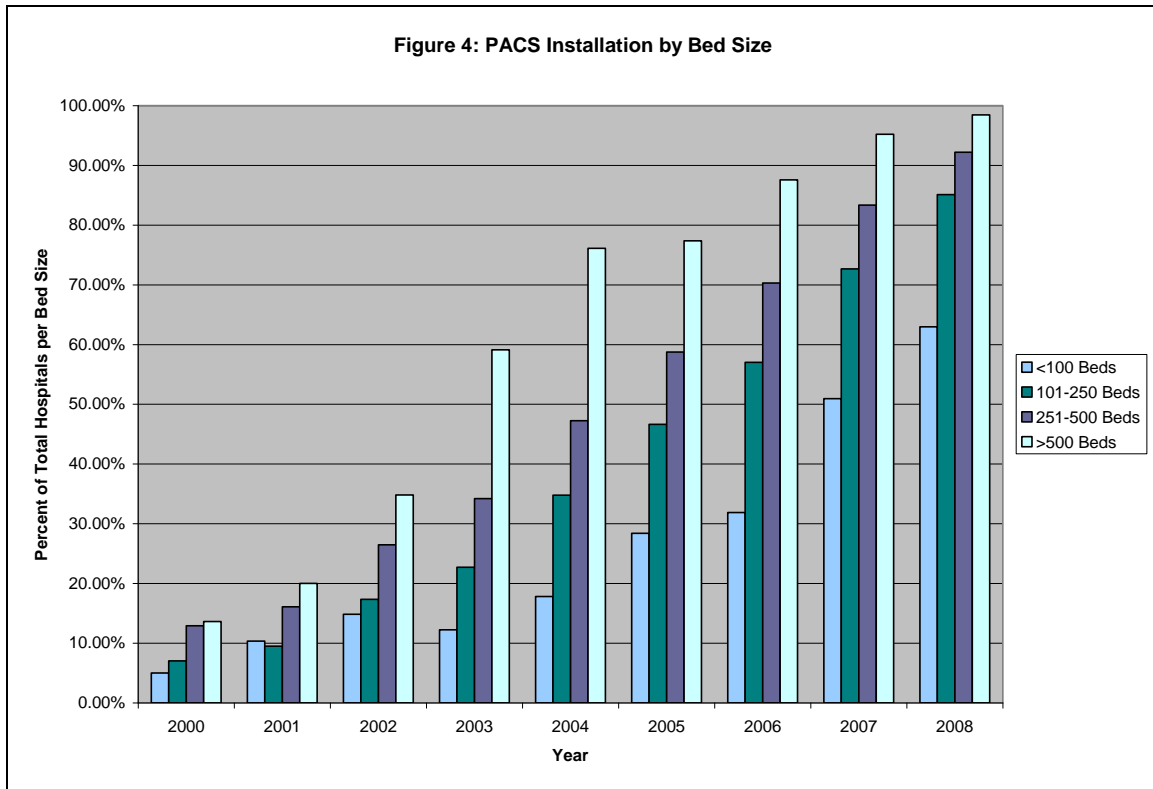


During each of the first three years of the collection of PACS installations, 9 hospitals reported plans for replacement software. Contracted plans for new PACS software purchases increased from 39 hospitals in 2000 and to 126 hospitals in 2002. Figure 3 outlines the number of hospitals reporting contracted replacement or new purchase plans. Over the five-year period of 2003 to 2008, the rate of replacement plans increased from 34 hospitals in 2005 to 54 hospitals in 2008. The converse is seen with the numbers of new purchases. In 2005, 445 hospitals indicated that a new installation was in process or recently contracted. This number decreased to 246 hospitals in 2008. Since 76.0 percent of all hospitals are fully automated for PACS, the number of new purchase plans has decreased.



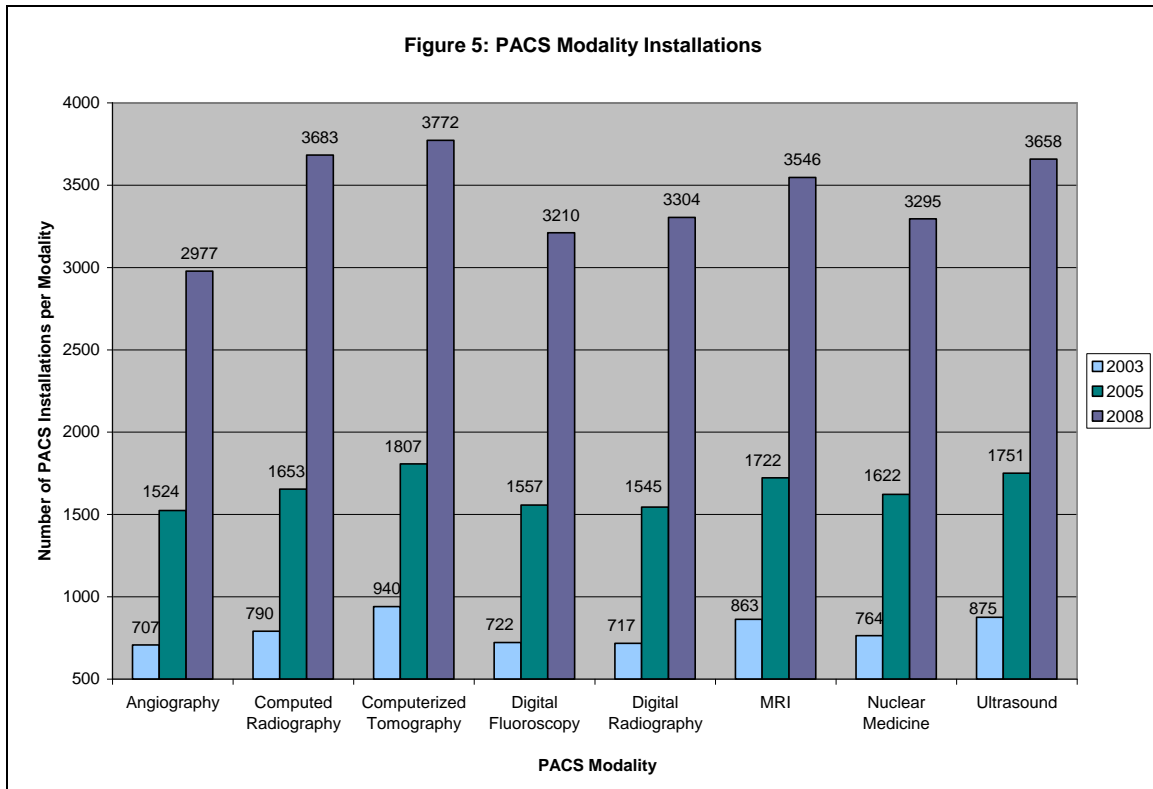
The data show that the greatest change in the PACS installations occurred between the 2006 and 2007 data collection years. During this time, the number of installations increased by 40.3 percent, or approximately 1,000 hospitals. This increase in hospitals reporting PACS software could be partially attributed to the addition of critical access and hospitals with fewer than 100 beds to the HIMSS Analytics database. A total of 1,063 hospitals were added by the end of 2007. PACS installation among these hospitals grew to 63.0 percent in 2008.

In 2005, over 50 percent of hospitals with more than 250 beds had PACS installed. The number of hospitals with PACS in this segment grew by approximately 45.7 percent and by 2008, 92.2 percent of hospitals with over 250 beds had PACS installed. The segment of hospitals with more than 500 beds has showed a steady growth rate. Figure 4 outlines the changes in the number of each installation by each bed size group. The largest increase in installation among hospitals of this size occurred between 2002, when installations were at 38.4 percent, and 2004, when installations reached 76.1 percent. Since 2004 the installation rate has increased at a more moderate level adding approximately 10 percent each year. As of 2008, 98.5 percent of hospitals with over 500 beds were live for PACS.



From 2000 until 2002, the PACS information was collected as a single application. Information regarding installation by different radiology PACS modalities was added to the study in 2003. The eight PACS modalities added were Angiography, Computed Radiography (CR), Computerized Tomography (CT), Digital Fluoroscopy (DF), Digital Radiography (DR), Magnetic Resonance Imaging (MRI), Nuclear Medicine and Ultrasound (US). In 2005 this increased to nine modalities when the application Digital Mammography was added. And in 2008 information about hospitals using PACS Orthopedic technology was also gathered.

Hospitals usually install PACS as a suite as displayed by the installation numbers for each modality. If not purchased as a suite, Computer Radiography, Computed Tomography, and MRI are often the first modalities installed at a hospital. Figure 5 uses data from the years 2003, 2005 and 2008 to outline the changes in these modalities. This chart also illustrates that hospitals appear to implement modalities over time, perhaps spreading out the cost burden and the training time needed for installation.



The collection of the Digital Mammography modality was added to the study in 2005. In that year 433 or 23.8 percent of hospitals reported having Digital Mammography installed. In 2008, 1,586 hospitals reported the use of Digital Mammography. Due to the specialized nature of digitizing these images, the installation rate remains half that of any other modality. The addition of the Orthopedic modality to the HIMSS Analytics database occurred in 2008. The Orthopedic modality is specialized for use in orthopedic practices to help assess prosthetic fittings in a pre-operative environment and during the actual surgery in the operating room. In 2008, 1,418 out of 3,928 hospitals using PACS reported using Orthopedic PACS.

Vendor Market Share

From 2000 through 2008 the number of vendors making PACS technology increased from 53 to 68. While there were fewer vendors early on, the percentage of the market occupied by the top ten vendors increased in 2003 to 80.1 percent and remained in the 80s each year through 2008. In 2000 the top ten vendors accounted for 70.3 percent of the market. From 2000 to 2002, the top five vendors accounted for around 50 percent of the entire market. This rose in 2003 to 61.2 percent and remained in the low sixties through 2008 when it was 63.1%.

During the time period from 2000 through 2008 there were some changes in the vendor shares for the top ten PACS vendors.

In 2000 and 2001 Siemens Medical Solutions had the top share of the market with 15.4 percent and 12.8 percent of the PACS vendor market. They remained one of the top ten vendors through 2008, although their overall share of the market decreased. From 2006 through 2008 they held constant as the sixth largest vendor with 7.5 percent, 6.4 percent and 5.4 percent of the market share respectively.

GE Healthcare has held the largest percentage of the market since 2002 for all PACS installations. They were one of the top ten vendors in 2000 and 2001 but accounted for less of the market with 4.1 percent and 8.6 percent of the market. They jumped to the top in 2002 with 13.7 percent of the market. Their market share increased to 19.0 percent in 2003, then 22.0 percent in 2006 and 21.9 percent in 2008.

Carestream Health, Inc., which emerged in 2007 when Onex Corporation purchased Eastman Kodak Company, was one of the top ten vendors from 2000 until 2008 when their share of the market dropped to 11th.

Since 2002 when Novarad Corporation sold their first PACS solution, their share of the market has grown. In 2006 they were the tenth largest vendor, and in 2007 and 2008 they climbed to having the seventh largest share of the market.

For many of the specific PACS modalities such as CT and MRI, the market shares held by the top ten vendors remained consistent with the general PACS market share from 2003 through 2008. There were variances in the percentage of the market held by a particular vendor such as in 2004 and 2006 for MRI, and in 2006 and 2008 for CT; however, the same companies were repeatedly the top ten vendors.

For Digital Mammography in 2005 and 2006, nine of the top ten vendors were the same as the general PACS market although the percentage of market shares by some of the vendors was different. GE Healthcare held the largest share of the market from 2005 through 2008 with more than 25% of the market. Hologic, Inc. was the ninth largest vendor in 2007 and seventh largest vendor in 2008. This vendor did not have any installations for modalities other than Digital Mammography.

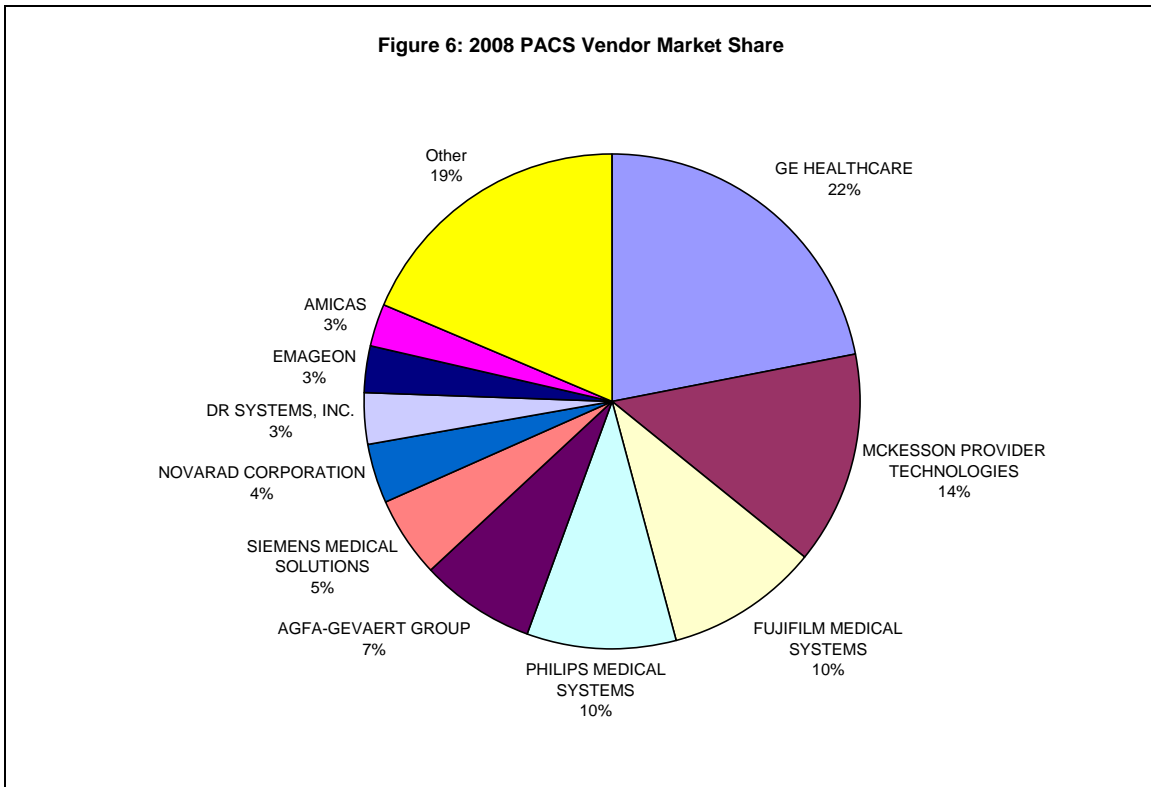
For Orthopedic PACS the top six vendors remained the same as the general market. GE Healthcare was the top vendor with 23.3% of the market. Amicas was the seventh largest PACS Orthopedic vendor with 3.2% of the market, compared to general market where they were the tenth largest vendor with 2.7% of the market.

Like other areas of the technology field from 2000 through 2008, there have been vendor mergers. Olicon Imaging Systems, Inc. (purchased by ALI Technologies Inc.'s in 1999 but was tracked as a separate vendor from 1999-2002) was the fourth largest PACS vendor in 2002, having 6.6 percent of the market. They were acquired by McKesson Information Solutions in 2002; however, they remained listed as a separate vendor in the database until 2003.

Philips Medical Systems had the sixth largest vendor share in 2004 with 6.2 percent of the market and moved up to the second largest vendor share position in 2005 with 11.2 percent after purchasing Stentor, Inc. the same year. In 2004 Stentor, Inc. had 4.5 percent of the market and was the eight largest vendor.

While GE Healthcare had been the top vendor in 2005, after purchasing IDX in 2006 their percentage of the market increased to 22.1 percent and remained over 20 percent through 2008.

In 2009 Amicas purchased Emageon. In 2008 Emageon had 3.2 percent of the market and was the ninth largest vendor and Amicas with 2.7 percent was the tenth largest vendor. Amicas' percentage of the 2009 market may follow these trends and increase. Figure 6 shows a breakdown of the vendors by the market share from 2008.



PACS Image Distribution

HIMSS Analytics began collecting additional information about hospital PACS environments in 2004. The specific questions added to the study asked about which departments of the hospital can access PACS images—Radiology Department only, CCU, ICU, ER or OR. Also asked was what type of locations can access the images—throughout the hospital, from physician offices, from physicians' homes, diagnostic imaging centers and via the Web. Starting in 2005, HIMSS Analytics began collecting information about how the radiology information system and the PACS software interfaced.

As more hospitals reported using PACS software, they also reported wider distribution of their PACS images. In 2004, at least 5.0 percent of all hospitals and 15.2 percent of hospitals with PACS indicated that their PACS images could be viewed outside of the radiology department. The ER was the most reported department with distributed images; 24.3 percent of hospitals with PACS indicated images were viewable in the ER.

These numbers increased in 2005 with at least 41.4 percent of hospitals with PACS reporting that images could be viewed in at least one other department. ER again was the most reported department at 51.7 percent of hospitals with PACS indicating that they could view images in the department. By 2008, at least 67.5 percent of hospitals with PACS or 51.3 percent of all hospitals reported that images could be viewed in other departments. Figure 7 represents the number of hospitals that reported distributing images to other departments.

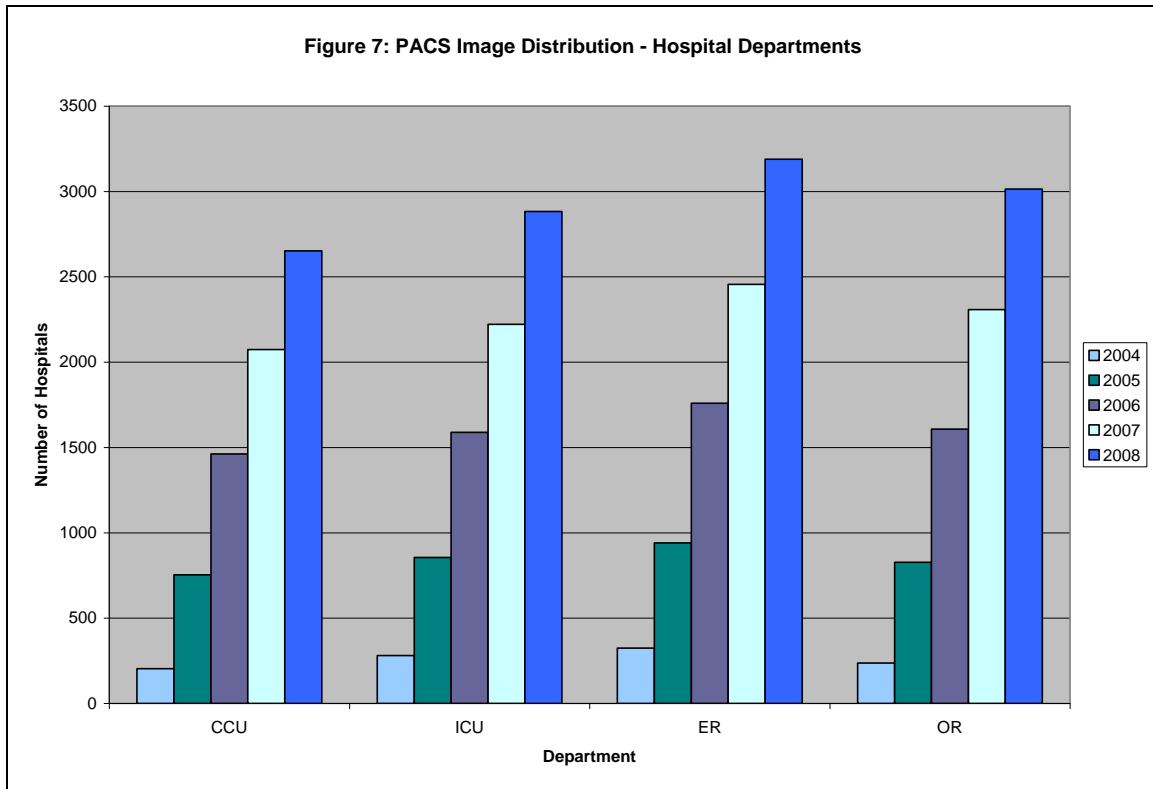
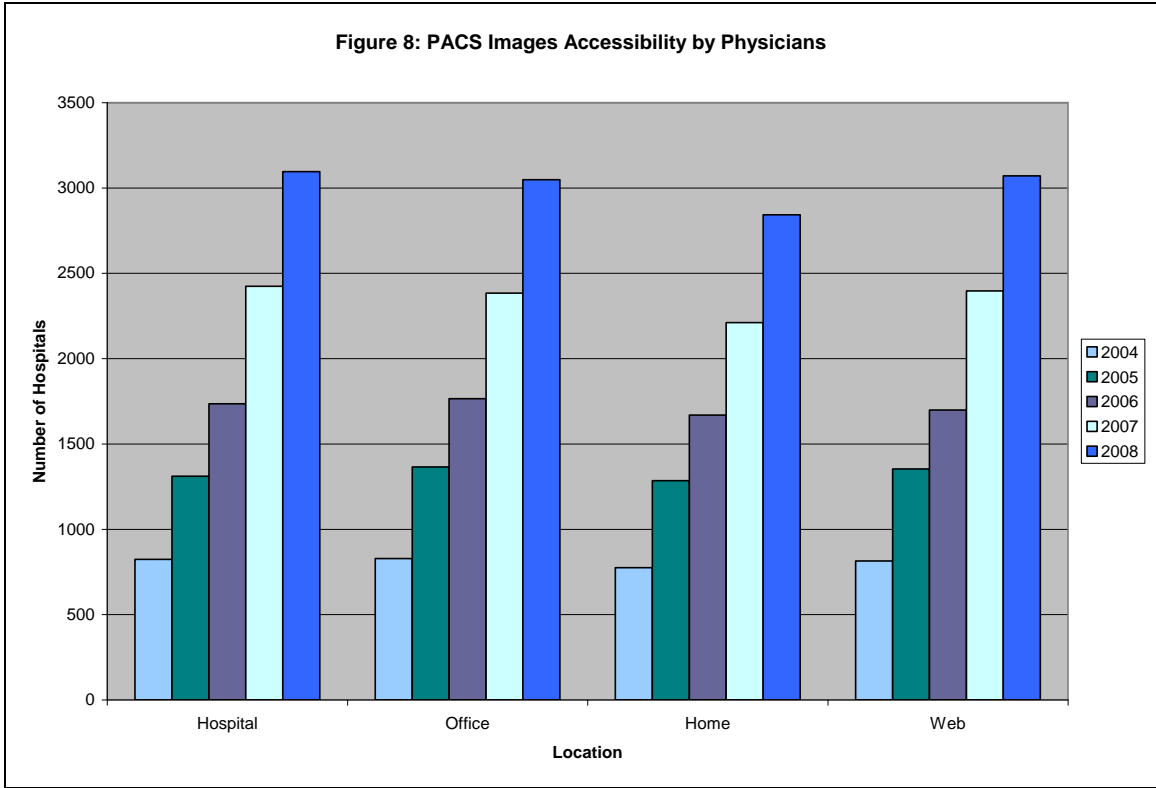
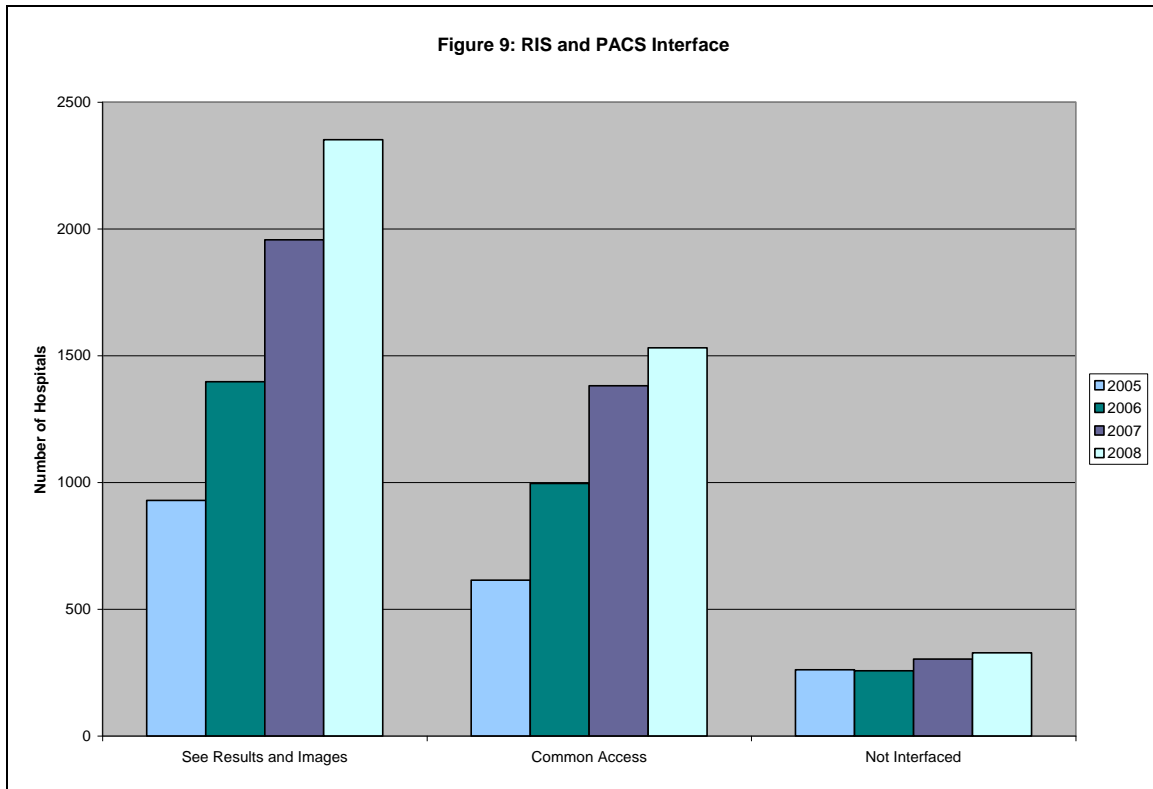


Image distribution outside of the hospital has also increased over the years. In 2004, at least 50.0 percent of hospitals with PACS indicated that PACS images could be viewed outside of the hospital. But this was only 16.7 percent of the total number of hospitals. By 2008, at least 53.2 percent of all hospitals and 70.0 percent of hospitals with PACS reported that their images could be viewed outside of the hospital. Between 2004 and 2006 physician offices was the most reported area outside of the hospital where images could be viewed. During these years of data collection, an average of 71.0 percent of hospitals with PACS reported that images were accessible in physician offices. In 2007 and 2008, 'Accessing Images via the Web' was the most reported answer with an average of 75.2 percent of hospitals with PACS reporting that their images were available over the Internet. During these years the response of physician offices was the second most reported answer at an average of 74.7 percent of hospitals with PACS. Figure 8 represents the number of hospitals that reported where PACS images were distributed outside of the hospital.



From 2005 to 2008, the data show that more radiology information system software systems were being interfaced with PACS software. In 2005, 14.3 percent of hospitals with PACS reported that their RIS and PACS were not interfaced. In 2008, this number dropped to 8.4 percent of hospitals with PACS. For the hospitals that did interface their RIS and PACS software, seeing the results and images together was the most reported response. In 2005, 51.0 percent of hospitals with PACS reported that the results and images were seen together through the PACS and RIS systems. In 2006, 59.1 percent of the hospitals with PACS reported that their results and images could be seen together and this number held steady through 2008. Figure 9 represents the number of hospitals that reported interfacing their PACS and RIS software.



The increase in PACS image distribution can be attributed to a number of factors. The most likely is the increase of hospitals reporting using PACS software. Another explanation could be that software vendors have expanded the capabilities of their products, and in doing so have allowed for more flexibility for the hospital. Also, the increasing usage of the Internet, physician portals and mobile devices by hospitals can help explain why images are more likely to be viewed from outside of the hospital. Some room for improvement by software vendors may lay with increasing the interface capabilities so hospitals are able to view images through both their PACS and RIS software.

Summary

As of 2008, 24 percent of hospitals in the United States reported that they did not have PACS software installed. Opportunities still exist in the market for first-time purchasers. Some hospitals have had their PACS software for a number of years and as software vendors make upgrades to their products, hospitals may be in the market for replacement software.

Image distribution may continue to spread outside of the hospital, as more procedures are performed in an outpatient setting or as technology enables users to access images outside of the hospital.

HIMSS Analytics' EMR Adoption ModelSM identifies and scores hospitals using an eight-step scale that charts the path to a fully paperless environment. HIMSS Analytics will

continue to collect information on the PACS environments in hospitals as PACS image distribution outside of the radiology department and fully automated radiology PACS modalities are a key to hospitals achieving a paperless patient record according to the HIMSS Analytics' EMR Adoption ModelSM. This data will also be important to help assess the market's movement toward data capture, reporting, and sharing measures that are being implemented as part of the goals of the 2009 American Recovery and Reinvestment Act (ARRA).

About The Dorenfest Institute for Health Information

The Dorenfest Institute for Health Information is an innovative online resource that helps meet the academic and global demand for healthcare information technology data to improve patient care. The Dorenfest Institute provides free historical data, reports, white papers and other tools regarding the use of IT in hospitals and integrated healthcare delivery networks. The institute was created thanks to a generous donation from Sheldon I. Dorenfest, President and CEO of the The Dorenfest Group in Chicago, Illinois. The Dorenfest Institute also maintains a historical database (acquired by HIMSS Analytics) that provides valuable data in healthcare IT.

About the HIMSS Foundation

The HIMSS Foundation serves as the philanthropic arm of HIMSS, providing support and assistance to the organization, its members, and the industry through:

- Financial assistance (scholarships) to students in healthcare-IT related fields.
- Providing free access for students, governments and others to The Dorenfest Institute database.
- Providing financial relief/assistance for special need-based programs issues.

The Foundation is an Illinois not-for-profit corporation organized and operated under Section 501(c)(3) of the Internal Revenue Service Code.

For more information on The Dorenfest Institute for Health Information and the HIMSS Foundation, visit www.himss.org/ASP/aboutHIMSSFoundation.asp, or contact Erica Pantuso, HIMSS Foundation, at epantuso@himss.org.

