High-resolution ophthalmic imaging systems are changing the way surgeons use diagnostic methods. In particular, optical coherence tomography (OCT), fluorescein angiography, and fundus autofluorescence imaging now provide us with information about the pathogenesis of a variety of eye diseases. These novel imaging techniques play an increasing role in decision-making for new treatment approaches, such as intravitreal injections for the treatment of posterior segment eye diseases. OCT, especially, is now an integral part of monitoring age-related macular degeneration and diabetic macular edema.

Long-established methods such as corneal topography, optical biometry, ultrasound imaging, and fundus photography have also evolved digitally, providing more sophisticated and precise diagnostic examination of the entire eye. Until now, results of these digital examinations were printed on paper, and sometimes then scanned and integrated into a patient’s electronic file. However, these practices can possibly lead to loss of therapy-relevant information. For example, if only one horizontal single scan of an epiretinal membrane OCT examination is printed for documentation without differentiated selection, other treatment-relevant information—such as a macular hole—could be lost and therefore appropriate treatment delayed (Figure 1).

Investigation of the entire digital data set, eliminating the losses that can occur with conversion from digital to analog (printed) form, can avoid the risk of changes in the images and therefore in consequent management decisions.

**Digital Image Management**

Another problem with digital imaging is the increasing number of imaging examinations needed in a steadily increasing patient load, producing a greater amount of data to be stored. This is especially true when a surgeon has multiple devices that each rely on the manufacturer’s unique software and database. Furthermore, seamless integration of specific imaging software in a hospital or practice’s information system is not always possible. Whereas the benefits of using a manufacturer’s specific software include precise adaptation to digital examination and any special software functions, the disadvantages include that each has a unique interface and that results from the various devices may be incompatible and cannot be analyzed side by side.

The growing number of ophthalmic imaging techniques and the resultant data volume is not a new phenomenon, as a similar trend occurred 20 years ago in the field of radiology. In 1993, a uniform data standard was created to govern communication among diagnostic devices and to regulate image compression, known as the digital imaging and communications in medicine (DICOM) format. Files in the DICOM format can be stored along with patient
demographics and digital work lists in a picture archiving and communication system (PACS). A central PACS server forms a hub to link all diagnostic equipment with computer monitors for viewing the images.

Now similar PACS technologies are available for ophthalmic use. Currently, the most common software solutions for ophthalmology include Merge Eye Care PACS (Merge Healthcare) and Forum (Carl Zeiss Meditec). The advantages of using the PACS approach are plentiful. First, data from various diagnostic devices is not only managed in one system but is also available at one glance, using only one application. Second, requesting and planning of examinations is possible through a clinic’s health information system. Third, because only one automated installation per workstation is required, there is a reduced administrative burden and a reduction of technology costs, and software updates can be managed easily and controlled centrally. Fourth, printouts of examination findings can be reduced, thus also saving time and material costs.

**FORUM IN CLINICAL PRACTICE**

As part of a pilot project, we recently integrated the Forum PACS into the health information system of the Department of Ophthalmology at Ludwig-Maximilians-University Munich. This PACS links all of the imaging devices we own using the DICOM protocol; if the DICOM format is not supported, a software-specific imaging data-grabbing protocol called Forum Link Net is used. Below we describe how Forum is used in our ophthalmology department. For more information on the other PACSs, see Data Management Systems, page 16.

Ophthalmologists request examinations using the health information system IS-H*med (Siemens Medical Solutions GSD GmbH). The requested examinations are sent with patient demographic data to Forum and, after the PACS distributes the planned examination and patient data to the relevant devices, the examination is conducted on the diagnostic devices and the results are returned to Forum. Then, IS-H*med recognizes each examination, and relevant services are calculated and linked to the patient visit.

The ophthalmologist can view any imaging results on all workstations in the network at any time. Additionally, he or she can examine an overview of all studies (Figure 2) or selected findings in a separate arrangement (Figure 3).

![Figure 2. Screenshot of patient list in Forum.](image)

![Figure 3. Screenshot of an overview of examinations in Forum.](image)

![Figure 4. Standard process steps of an OCT examination. The steps outlined in red can be significantly reduced by using Forum.](image)

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Results favored use of the PACS because of its potential savings in time and costs, including printing of results and documentation of analyses (Figure 4). Assuming a volume of 30 patients per day, our analysis projected a saving of about 5 weeks of work time per year and of almost €10,000 in printing costs.

**CONCLUSION**

The use of a PACS across the entire spectrum of ophthalmic imaging systems offers a high degree of user-friendliness and diagnostic quality.

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