Imaging Informatics for Healthcare Professionals

Peter M. A. van Ooijen *Editor*

Basic Knowledge of Medical Imaging Informatics

Undergraduate Level and Level I

Springer

Imaging Informatics for Healthcare Professionals

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The series Imaging Informatics for Healthcare Professionals is the ideal starting point for physicians and residents and students in radiology and nuclear medicine who wish to learn the basics in different areas of medical imaging informatics. Each volume is a short pocket-sized book that is designed for easy learning and reference.

The scope of the series is based on the Medical Imaging Informatics subsections of the European Society of Radiology (ESR) European Training Curriculum, as proposed by ESR and the European Society of Medical Imaging Informatics (EuSoMII). The series, which is endorsed by EuSoMII, will cover the curricula for Undergraduate Radiological Education and for the level I and II training programmes. The curriculum for the level III training programme will be covered at a later date. It will offer frequent updates as and when new topics arise.

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Preface

This book series has the aim to provide insight into the vast field of Medical Imaging Informatics in a way that allows medical students, residents in radiology and radiologists at all levels of training to become familiar with the different concepts and possibilities of Medical Imaging Informatics.

The schedule of radiology residents is already full and time is limited to study all relevant topics. Then why adding technical courses to this? And even computer science? Does this help? Is it relevant?

The role and presence of information technology is growing in our day-to-day life and also in healthcare. Traditionally, radiology is one of the areas in healthcare that is a front runner in the implementation of computerized systems.

This started with the introduction of computed tomography and magnetic resonance imaging that increased the interest in data storage, computerized data handling and display and rendering of the imaging data.

Currently, the developments are not only pushed forward by the medical imaging industry but also by the consumer market introducing new IT developments like Social Media, Big Data analysis, Cloud Computing, etc. into the realm of diagnostic imaging.

The medical imaging industry itself embarks on ever-increasing production of imaging data that should be analysed and diagnosed. Other developments are in the direction of quantification and computer-aided decision support, detection and diagnosis.

These developments become part of the regular working day of the radiologist and the radiology resident. It is therefore crucial for them to be able to understand the background and consequences of these new and sometimes disruptive developments from an application point of view.

This first volume aims to provide information for undergraduate students on the basic infrastructure of imaging informatics, including Picture Archiving and Communication Systems (PACS) and Radiological Information Systems (RIS). This is following the Curriculum as published by the European Society of Radiology and endorsed by the European Society of Medical Imaging Informatics.

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Peter M. A. van Ooijen

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1.1 Introduction

When medical imaging started with the invention of the X-ray by Wilhelm Conrad Rontgen, it quickly developed the field of radiology as a film-based operation that lasted for quite some time, and although transition to a digital operation started in the late twentieth century, the use of film was still frequent in the beginning of the twenty-first century.

In the nineties of the twentieth century, the introduction of digital scanning of patients with computed tomography (CT) and magnetic resonance imaging (MRI) provided the radiology department with an increasing amount of digital data on removable media like digital linear tape (DLT) and magnetic optical disk (MOD). This increasing amount of data became less accessible when it grew. Because of this, digital storage systems were built. At first these were just proprietary modality specific storage solutions that, when the existing modalities were steadily digitized, slowly evolved into large central databases and storage systems containing all the imaging data from the radiology department. The modality-specific storage solutions relied on proprietary portable media systems, and a disk produced by one system vendor could not be used by others. Clearly, this had many disadvantages that led to the development of new storage solutions which were increasingly more centralized and standardized. Development of these department wide implementations eventually resulted in integrated systems that functioned within the department as a standards-based Picture Archiving and Communication System (PACS) solution.

Nowadays, most hospitals have transitioned to a fully digital operation and have expanded their radiology PACS solutions to enterprise wide imaging archives storing data not only from radiology but also from other imaging data producing departments and providing access to the imaging data to the whole enterprise for further use in patient care and treatment planning and evaluation [1]. Although this was and is not always regarded as an entirely positive development [2], digital imaging is here to stay.

1.2 The Growing Amount of Data as Driver

The evolution of MR and CT caused a rapid increase in the number of images produced. On the one hand, the use of CT and MR became more popular and with increasing installations and imaging requests the number of patients scanned on these imaging devices increased rapidly. Besides that, the rapid development of scan technology further increased data production. This was especially apparent in CT, where development from single detector/single slice acquisition to multi-detector systems with continuous (spiral) acquisition of data resulted in a dramatic increase in the number of images produced per examination [3].

Moreover, an increasing number of acquisition devices became direct digital or were digitized, which made acquisition and storage of large amounts of digital data easier and more convenient.

This development also led to the introduction of workstations with small storage solutions attached to the actual acquisition devices in order to review the acquired images and to perform selection of the images to be printed on physical film. This selection was required since review was often still performed on lightboxes and printing all slices acquired on CT and MR would result in too large a stack of films to allow proper review. However, this also meant that the interpretation of the imaging data was limited to what could be printed and review of the images in a tiled printed manner became an increasing challenge.

The introduction of both digital storage and review of the imaging data therefore became a necessity to further the development of digital radiology and to allow further increase of the amount of data acquired per patient.

This led to the development of the digital environment of the radiologist containing the already longer existing Radiological Information System (RIS) and the Picture Archiving and Communications System (PACS). The RIS contains mainly textual information on the patient such as examination schedules, worklists, radiological reports, patient demographics, while the PACS contains the image data acquired by the different imaging modalities.