Exchange of radiological images on DICOM CD

A survey of the state of technology in Germany

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Introduction and background

- **Exchange of radiological images on digital storage media („patient CDs“) increasingly popular**
  - Original image quality (DICOM)
  - Suitable for diagnostics, postprocessing, therapy planning, …
  - Much lower costs than conventional film
- **However, exchange of patient CDs currently not without problems**
  - CDs physically not readable
  - Invalid DICOM objects (especially DICOMDIR)
  - Deficient DICOM viewer on CD
- **German law requires: “Appropriate access to radiological images”**
  - §28 (6) of the X-Ray Ordinance („Röntgenverordnung“)
- **Problems reported to the German Radiological Society (“Deutsche Röntgengesellschaft”, DRG)**
  - 2005, DRG started an QA initiative for improving the quality of patient CDs

DRG CD Initiative: Overview

- **Three building blocks**
  - Technical CD specification for “best practice” patient CD
  - Validation procedure for products creating patient CDs
  - Import guidelines for receiver of patient CDs
- **Technical specification**
  - Based on IHE profile “Portable Data for Imaging” (PDI)
  - Minor differences to PDI but harmonization in progress
- **Validation procedure for products**
  - Extensive checking of patient CDs created by products
- **Import guidelines, with two scenarios**
  - Simple visualization
  - Import into PACS
  - Based on IHE profile “Import Reconciliation Workflow” (IRWF)

DRG CD Initiative: CD specification

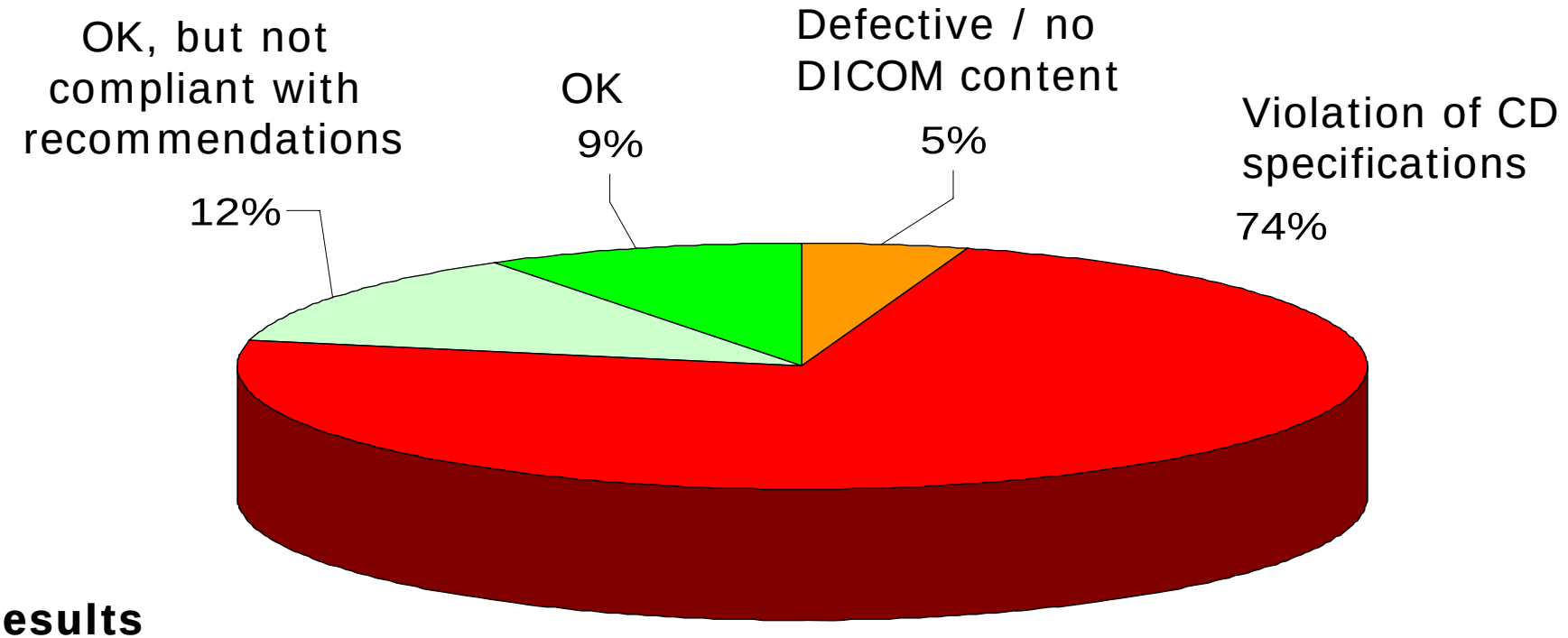
- **CD format**
  - CD-R or CD-RW (prepared for DVD)
  - ISO 9660 Level 1 (Rockridge, Joliet allowed), no packet writing
  - Multi-session allowed but may be dangerous
- **Three types of content**
  - Medical images in DICOM format required
  - DICOM viewer and IHE web content allowed
  - “Other content” optional (reports, discharge letters etc.)
- **Malicious software**
  - Creator needs to verify that no viruses / trojans are on the CD
- **Recommendation for CD labeling**
  - Patient’s name, patient’s birth date, patient ID (e. g. for PACS import)
  - Creator of CD, date of study, type of content, …

DRG CD Initiative: DICOM content and viewer

- **Strict DICOM conformance required**
  - Various DICOM application profiles supported (extension to PDI)
  - DICOMDIR required, DICOM directory and file naming rules apply
  - All medical images have to be stored in DICOM format
- **Compression is possible**
  - Lossy image compression only if this is the original image format
  - Application profile STD-GEN-DVD-JPEG explicitly allowed for CD media
- **CDs may contain data for one or more patients**
  - Multi-patient CDs only useful for very specific purposes (QA, clinical studies)
- **Recommendation: All clinically relevant content stored in DICOM format**
  - With DICOM Encapsulated PDF, there is no excuse not to use DICOM
- **DICOM viewer**
  - Must run without administrator privileges and without additional installations
  - Must be able to display all DICOM objects on the CD
  - PDF manual and short printed manual recommended
  - Recommendation for not using “autostart” feature

DRG CD Initiative: Live test at DRK 2006

- **At the "Deutsche Röntgenkongress" (DRK) 2006, radiologists were invited to bring their patient CDs for a short live test (against the DRG CD specification) to the DRG exhibition booth**



- **Test results**
  - Almost 80% of the tested "real world" CDs failed!
  - This clearly shows that - despite all the activities of DICOM and IHE – a quality assurance program is really needed

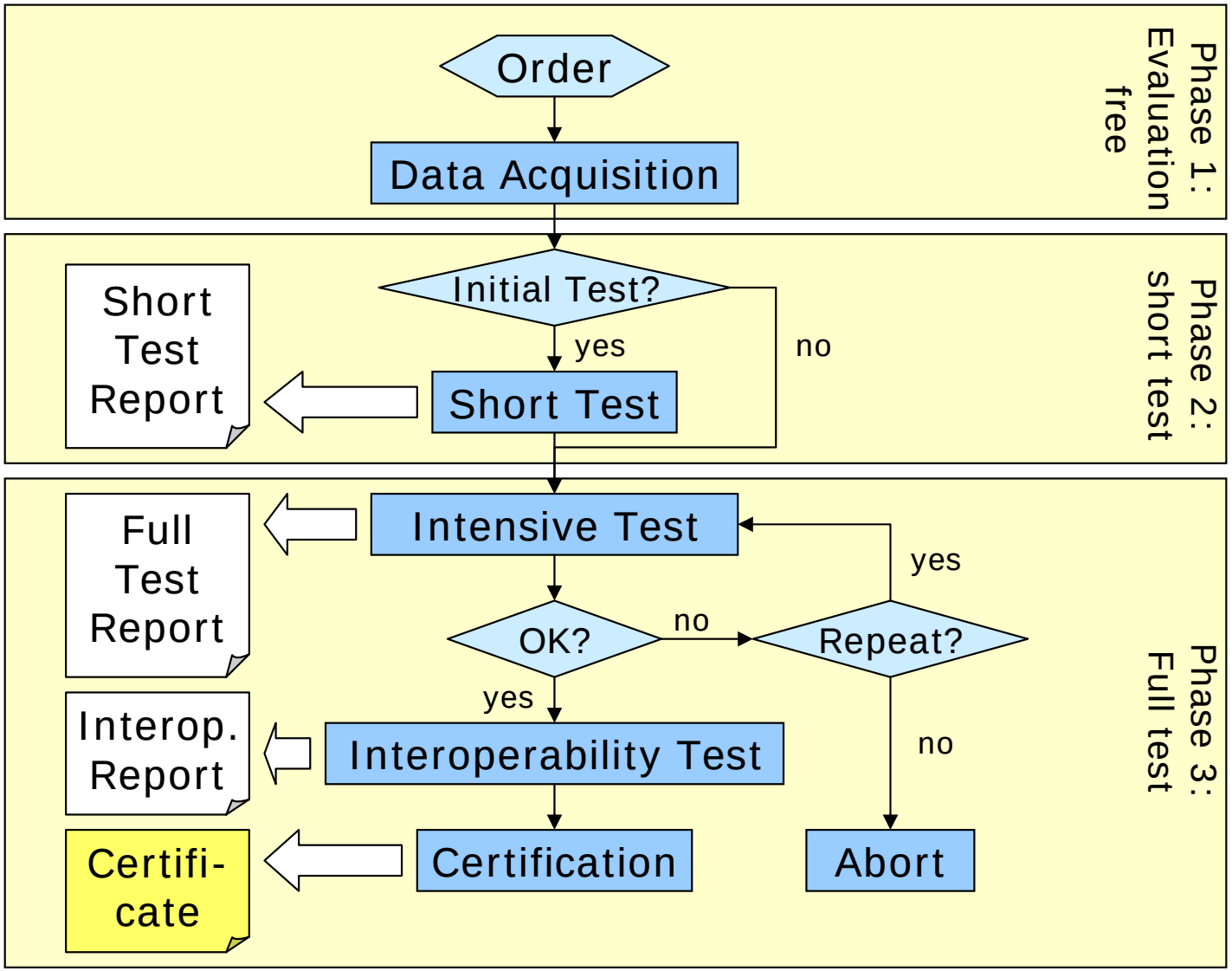
DRG CD Initiative: Live test results

- **Typical DICOM errors**
  - DICOM rules for filenames and directory names violated (beginner's mistake!)
  - Missing/empty required fields in DICOMDIR
  - Syntax rules for DICOM data types violated
  - Incorrect transfer syntax for DICOM images (Implicit VR)

- **Typical problems with the DICOM viewer**
  - Required administrator privileges or does not run at all (Windows XP system)
  - Tries to install software components (Java or .NET runtime)
  - Tries to write in C:\WINDOWS
  - Cannot display all images on the CD
  - Often no documentation, no manual

- **CD labeling often missing, almost always incomplete**
- **In summary, most of these problems would be easy to avoid for the software vendor.**

DRG CD Initiative: Validation process diagram



DRG CD Initiative: Testing process

- **After evaluation phase, company signs and sends product info to OFFIS**
  - Conformance Statement, manual (if available), other describing information
- **OFFIS assembles DICOM objects matching product characteristics**
  - Application profiles (AP), SOP classes and (SOP), Transfer Syntaxes (TS)
- **Company burns DICOM test data onto CDs and sends them to OFFIS**
  - Import into product using DICOM storage tool provided by OFFIS
  - Possibly more than one CD (different AP/SOP/TS)
- **OFFIS validates CDs**
  - Short test results sent to company (“homework” to do)
  - After receiving a new set of CDs from company, full test is performed
  - Semi-automated tool chain, lots of manual testing
  - If successful, interoperability test is done and certificate is granted
  - Company can repeat full test (charged) or drop out from process at any time

DRG CD Initiative: Current status

- **Since April 2007, registration for DRG CD validation is possible**
- **OFFIS responsible for performing tests on behalf of DRG**
  - Company signs contracts with OFFIS
  - OFFIS performs short/full test (phase 2 and 3)
  - Certificates granted jointly by OFFIS and DRG
- **Five companies already entered phase 2 and 3**
  - Another six companies in phase 1 (evaluation)
  - First certified products expected by mid-2007
- **Expiring of a DRG certificate**
  - Certificates granted for two full calendar years
    (i. e. all certificates from 2007 will expire at the end of 2009)

Conclusion and outlook

- **Currently majority of patient CDs (>70% at DRK 2006) faulty**
  - Often “simple” DICOM errors (file names, inconsistent DICOMDIR, …)
  - Problems with viewer (requires administrator privileges, does not display all DICOM objects on CD, …)
- **DRG QA initiative aims at establishing wide base of products creating best-practice patient CDs which will bring advantage for**
  - CD creators (customers), being sure to burn correct CDs
  - Receivers, being sure to receive correct CDs and to do PACS import correctly
  - Companies, being sure to create correct CDs and spending less time on appeasing annoyed customers
- **Hopefully, during the next years …**
  - CD quality will increase significantly and
  - DRG initiative will become superfluous…

Thank you for your attention!

http://www.dicom-cd.de/