MEETING ABSTRACTS

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ORAL PRESENTATIONS

S1
Medicine and humanities in the era of electronic information exchange
Anna Batistatou
Department of Pathology, University of Ioannina, Medical School, Ioannina, Greece
E-mail: abatista@cc.uoi.gr
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Medical humanities is a multidisciplinary field, consisting of humanities, social sciences and arts, integrated in the curriculum of Medical undergraduate and graduate schools, as well as in residency programs and continuing medical education. All sciences included in Medical Humanities contribute to the high quality education of doctors and practice of medicine, and they are more important today, where medical practice is dominated by evidenced-based-medicine. The digital age, provides a unique opportunity for facilitating exposure and participation of all doctors to medical humanities. Digital media offer connection and interaction between scientists, and exchange of ideas in a large scale. Online publications are offering a unique opportunity for fast and widely distributed communication of information. Due to current technology, the conversion of image to pixels is now possible. Digitalizing the glass slide enables independency from it. Pathologists create, view, analyze and manage digital slides. Telepathology diagnostic networks have aided pathologists worldwide. These advantages are leading to the globalization of pathology teaching and practice. However, it is well-established that human factors issues are critical for such telemedicine systems, and medical humanities can shape these factors. A good example of the application of humanities in pathology in the digital era is the study of human factors that affect proficiency of pathologists as light microscopists. Cognitive psychology, using eye position tracking devices has shown that mentor and trainee viewing activities are not identical – eye movements reflect levels of surgical pathology expertise. Thus, cognitive factors that contribute to the gaining of expertise in diagnostic pathology can now be assessed.

In conclusion, medical humanities induce the development of observational skills and analytical reasoning; provide insight into human conditions, illness and suffering, perception of oneself, as well as into professionalism and responsibilities to self and others. The exchange of electronic information can greatly facilitate exposure to the disciplines and materials of medical humanities and provides active participation of all doctors in this novel field, the goal being personal and scientific enrichment.

S2
Digital slide and virtual microscope based graduate and postgraduate education program: a 3 year experience
László Fönyad1, László Gerely1, Mária Cserneky1, Béla Molnár2 and András Matolcsy3
11st. Dept. of Pathology and Experimental Cancer Research, Semmelweis University, Budapest, Hungary; 23DHISTECH Ltd., Budapest, Hungary
E-mail: fonyadla@gmail.com
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Background: The success and spreading of digital microscopes Worldwide is unquestionable. During the past 3-5 years the vendors in the field of digital microscopy developed robust hardwares and sophisticated softwares. Digital slides become a part of everyday life in research and now claim their place in the routine pathology workflow also. Still one of the most popular field of using these applications where we can really take advantage of them is education. Our department has always been a pioneer applying digital slides. On the ECP 2007. We reported the development of an educational software package: E-School. After the successful introduction of the system, we decided to replace all optical microscopes in education, with computers. First results were presented in the IAP congress in Athens in 2008.

Methods and results: We set up a digital histology lab with 40 commercially available PCs, a slide server and built up an intranet that connects the 40 PCs with the teacher’s laptop and the local server. We digitized 200 slides. (The revised educational material completed with special stains and IHC-slides.) The slides were uploaded to a slide server, www.pathonet.com, with 24 hour external access service for our students to the entire material. During exam periods there are over 100.000 page loads/month (by the average 350 students/semester). In the last years our new lab served 1000 hours of histology practice. The satisfaction tests provided excellent results and served valuable information on how to continue the development of our digital lab.

Conclusions: Going digital didn’t solve all our problem, rather generated new ones. Still we are confirmed that digital slides have got numerous advantages over optical slides and are better to use in education. Medical education is very expensive everywhere in the World, thus students claim for standardisation, for the same opportunities and circumstances. With DS universities got the opportunity to provide exactly the same quality material for all the students.
S3
Digital slide and virtual microscope based graduate and postgraduate education program: 3 year experience

László Fónyad
1st. Dept. of Pathology and Experimental Cancer Research, Semmelweis University, Budapest, Hungary
E-mail: fonyiad@gmail.com
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Background: In the last years we have witnessed that after the initial enthusiasm for digital microscopy some serious constraints revealed mainly related to information technology, rather than the diagnostic accuracy, such as the issue of proper and cheap storage capacity, slow processors, low resolution monitors. Although these problems have been more or less resolved by now, the real revolution of digital slides are still waited for. Their use is still limited to research, education and as a paradoxic quality control. The question arises: why should we use digital slides in education. Using digital slides – is it just a goal or there is more than this?

Methods and results: After succesful pilot studies with digital microscopes, 3 years ago, we decided to replace all optical microscopes with computers. We set up a lab with 40 commercially available PCs and two servers (both internal and external access). The lab served more than 1000 hours. Student feedback showed both weak and strong points of the system. The real drawback was the speed when simultaneously connecting servers and PCs from a remote to build up teleconsultation settings. Reducing the file size using bigger compression level and modifying the tile size of the original scanned fields according to the resolution of the monitors have solved this problem. Uploading the slides to a public server was very popular. During exam periods there were over 100,000 page loads/month (by the average 350 students/semester!).

Conclusions: We all know that once higher education is costly the students demands the same circumstances. During the semesters and for the exams too. It could only be reached by using standardized material compiled with digital slides. Using digital slides in education has another important impact on digital slides in routine pathology. We think, when the students’ first impression of histopathology is related to digital slides, later the residents will be looking for it and will use it securely with confidence promoting the acceptance of this technique!

S4
BPMM in practice. Experiences of business modeling in the Department of Pathology

Marcial García Rojo1, Luis Calahorra2 and Francisco Ruiz3
1Urology Department, Hospital General de Ciudad Real, Ciudad Real, Spain; 2Pathology Department, Hospital General of Ciudad Real, Ciudad Real, Spain; 3Faculty of Computer Science: University of Castilla-La Mancha, Ciudad Real, Spain
E-mail: marcial@cim.es
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Background: Orientation to processes is one of the essential elements of Quality Management Systems, including those currently in use in healthcare. BPMM (Business Processes Modeling Notation) is a language designed specifically for modeling business processes (organizational). Without required special expertise, BPMM provides a graphical notation for expressing all aspects of the processes using a single type of diagram. We present our experience in modeling Anatomic Pathology processes within the Programmed Surgical Patient (PSP) process and the use of BPMS (Business Process Management Systems) tools in our hospital.

Methods: The applied research method was Action-Research (A-R). A-R is a collaborative research method aimed at joining theory and practice between researchers and practitioners by means of a process of a cyclical nature.

Results: Programmed Surgical Patient process includes both a high level abstraction and detailed description of the PSP process and the activities that are carried out when a patient is admitted into the hospital for the accomplishment of the surgical treatment of a disease that has been clinically diagnosed previously.

The modeling of the processes of Anatomic Pathology is presented through the notation BPMM. The presented subprocesses are those corresponding to the surgical pathology examination of specimens coming from operating theatre, including the frozen studies and the complete internal circuit in the Pathology department that results in the Pathology report and its submission to the corresponding clinical department.

Conclusions: The introduction of a software tool to support process modeling management with the BPMM notation promotes continuous improvement of the effectiveness and safety of processes in both healthcare and other applications (research, education) and increases patient and professional satisfaction.

Creating a multidisciplinary working group has been an efficient method to analyze the use of BPMM notation in real cases in healthcare.

The modeling of the programmed surgical patient process and its subprocesses has allowed to us the preparation of an understandable model for the involved health professionals and makes easier the communication of processes. Additionally, modeling allows early detection and correction of errors. This work is an essential previous step for further analysis and improvements in healthcare processes, including the adoption of information technology standards.

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S5
Two years experience in the telepathology network of Castilla-La Mancha

Marcial García Rojo, Carlos Peces, Jose Sacristan and Antonio del Barrio
Servicio de Anatomía Patológica, Hospital General de Ciudad Real, SESCAM, c/ Obispo Rafael Torija, s/n. 13005 Ciudad Real, Spain
E-mail: marcial@cim.es
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Background: Pathology images are being used in a digital format in most Pathology Departments. However, management of these digital images is usually very inefficient. Standard solutions for acquiring, archiving and communication of these digital images are under development.

Methods: The Public Health Service of Castilla La Mancha (SESCAM) developed the “Serendipia project” with the aim of creating an efficient inter-communication tool between the Departments of Pathology of eight public hospitals, using a standard web platform, based on a partnership model of European scope.

To achieve these objectives, the project has been based on the main guidelines and medical standards (IHES, HL7, DICOM and SNOMED-CT).

Different types of devices were purchased to cover all kind of images that can be generated in a Pathology Department, including grossing images (biopsy and autopsy), microscopic images, and virtual slides. At the moment, because of the slowness of digital scanners (around 15 minutes per images at 40x) not every case is being digitized. Initially, only those requiring collaborative work, those of high scientific or teaching interest are digitized.

Results: The main functionalities of the project are the integration with the Hospital Information System (HIS); storage of all the images generated by the Pathology Department in the PACS (Picture Archiving and Communication Systems), including virtual slides; a unique viewer that allows showing, at the same time, macroscopic, microscopic images, and virtual slides; and a centralized web telepathology portal including second opinion, teleconsultation forum, and a education public library with over 800 virtual slides.

Conclusions: By using the teleconsultation and the distance diagnostics through digital imaging will offset the shortage of specialist in Castilla-La Mancha region.

The digitalization of Pathology images allow including them in the Electronic Medical Record project of the Healthcare Service of Castilla-La Mancha. This solution allows other specialists, like dermatologist or haematologist, to have access to this kind of images. As well as improve the training of students and medical residents.

Finally, by using the medical standard in the development of the SERENDPIA project will provide, in the future, an interconnection with others telepathology networks for access, exchange, and upgrade electronic medical records through the Internet.

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http://www.biomedcentral.com/1746-1596/5?issue=S1
Information Technology (IT) in Histopathology (HIS)

Jürgen Goettler, Klaus Kayser1 and Gian Kayser1
1 IBM Germany, Stuttgart, Germany; 2 UICC-TPCC, Institute of Pathology, Charité, Berlin, Germany; 3 Institute of Pathology University Freiburg, Freiburg, Germany

E-mail: Goettler@de.ibm.com

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Background: Based on the developments in radiology in the last twenty years image digitalization moved into all different medical disciplines and is subject for integration into a Hospital Information System open and shared among Internet as a backbone. This discussion will introduce the wider context of the foundation of recent developments given the global standardization and will give examples on what can be implemented already. IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical need in support of optimal patient care. Systems developed in accordance with IHE communicate with one another better, are easier to implement, and enable care providers to use information more effectively.

Standards: Health Level Seven (HL7) is an all-volunteer, not-for-profit organization involved in the development of international healthcare standards. "HL7" is also used to refer to some of the specific standards created by the organization. HL7 and its members provide a framework (and related standards) for the exchange, integration, sharing and retrieval of electronic health information. v2.x of the standards, which support clinical practice and the management, delivery, and evaluation of health services, are the most commonly used in the world.

In medical imaging, picture archiving and communication system (PACS) are computers, commonly servers, dedicated to the storage, retrieval, distribution and presentation of images. The most common format for image storage is DICOM (Digital Imaging and Communications in Medicine). Electronic images and reports are transmitted digitally via PACS; this eliminates the need to DICOM (Digital Imaging and Communications in Medicine). Electronic images and reports are transmitted digitally via PACS; this eliminates the need to healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical need in support of optimal patient care. Systems developed in accordance with IHE communicate with one another better, are easier to implement, and enable care providers to use information more effectively.

Digital Imaging and Communications in Medicine (DICOM) is a standard for handling, storing, printing, and transmitting information in medical imaging. It includes a file format definition and a network communications protocol. The communication protocol is an application protocol that uses TCP/IP to communicate between systems. DICOM enables the integration of scanners, servers, workstations, printers, and network hardware from multiple manufacturers into a picture archiving and communication system (PACS). DICOM has been widely adopted by hospitals and is making inroads in smaller applications like dentists' and doctors' offices.

One example of an applicable IT architecture is the IBM GMAS (Grid Medical Archiving Solution), which can help you securely store and efficiently transmit diagnostic images and documents within your organisation or across multi-site facilities. By combining the power of grid computing with intelligent information lifecycle management the result is an ability to deliver patient images wherever they’re needed - at the moment they’re needed - which can lead to improved diagnosis and treatment.

Conclusions: Today’s standards and architectures and the variety of building blocks ready to be used for building solutions will enable physicians to speed up their work and increase the quality of work. Many users across the globe use it for their daily work, for communication with their peers and for education of the new generation of pathologists. Those IT solutions link together records or storage resources among multiple campuses or remote facilities, treat distributed images and remote files as if they were local, automatically create multiple replicas of images at distributed sites on the grid - and enable automated fail over to those copies in case of a disaster or unplanned downtime. Further foreseeable work in providing Internet tools and databases and visionary thinking will provide major progress soon in an advanced use of digital technologies in the pathology practice.

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Dataset development: The College commissions experienced pathologists to produce each dataset to a standard format which includes clearly defined core data items that evidence indicates are required for optimal patient management and prognosis and non-core, data items that are included in a comprehensive report or to meet local clinical or research requirements. Quality assurance of the guidelines is monitored by the standards of the AGREE Collaboration. A national approach to standards of pathology laboratory software will encourage the incorporation of structured data acquisition and storage into laboratory information systems. Core pathology data form part of the National Cancer Dataset and clinical guidelines, encouraging pathologists to provide the data in routine practice thereby facilitating clinical audit and the transmission of data to other clinical systems.

Summary: The cancer datasets published by the Royal College of Pathologists are an accepted quality standard for the delivery of cancer services. This is largely due to the enthusiasm, experience and wisdom of the authors and clear definitions of data items. The challenges for the future include keeping the datasets up to date, the incorporation of molecular data and the implementation of IT systems that will allow the multifunctional use of pathology data as the basis of modern cancer care.

High throughput equipment, like tissue arrayer and autostainer, has meanwhile been integrated in pathology and research on a daily-use basis and provides comparability, reproducibility and celerity of processing. Since molecular investigations possessing high throughput characteristics (transcription arrays and 2-D-electrophoresis) can be combined with this equipment, efficient strategies to find disease-relevant molecules can be developed. In this study transcription array data derived from human lungs, tumor and tumor-free specimens, was evaluated to disclose strong gene regulations. Candidate molecules, one of which was haptoglobin, were found and studied intensively employing high throughput immunohistochemistry. For evaluation of signals from immunohistochemistry, an automated stand-alone tissue microarray detection system (“Spot Browser”) was used to analyze stained tissue microarrays. We describe different technical and molecular high throughput tools whose combination represents an efficient strategy for the identification of most important candidate molecules with high importance in the field of lung diseases including cancer, inflammation, allergy, and infection. All tissue conservation was further based on the formalin-, ethanol- and xylol-free HOPE-fixation which provides equal to formalin and avoids protein cross-linking and degradation of RNA and DNA in a long-term manner; moreover, all molecular-biologic and biochemical methods are compatible. In conclusion, HOPE-fixed tissues processed with high throughput equipment and analyzed using molecular high throughput techniques provide a powerful combination as the basis for multi-methodical investigations of archived tissue specimens and therefore for the fast detection of disease-associated molecules.

With the development of a new generation of slide scanner fort he generation of whole digital slides this technique is on its verge into routine histopathological diagnostics. Therefore the demand for standardized image acquisition and display needs to be fulfilled. Upon a physical and physiological basis the maximum performance are to be the cornerstones of this demand. Since with virtual slides huge data amounts have to be handled image compression is also an important issue. Therefore we analyzed the impact on jpeg image compression in 50 cases on 1) highest usable magnification, 2) security of diagnosis, 3) scan time and 4) data compression. The slides were digitized using a Zeiss MiraxScan in 11 different available qualitysteps (100%, 90%, 85%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 10%) and diagnosis was made for each case by three different pathologists. Throughout no misdiagnoses were made, but diagnostic security was rated as “good” only in qualitysteps of 40% and higher in all cases. From this qualitystep upwards magnifications of 40x were also rated as “good”. Concerning scanning times a significant decrease in time was already observed by compression in qualitystep 90% and decreased further with decreased dataamount indicating a dependency on networkspeed. Furthermore, compressionrates of approximately 20% already in the 90% qualitystep were obtained and decreased further to 8% in the 10% qualitystep. In conclusion the following standards for acquisition of virtual slides are required to 1) a pixel resolution of 0,2 x 0,2 μm, 2) for the Mirax scan compression with qualitysteps of 40 to 80% are acceptable for routine histologic diagnosis. For display of virtual slides we propose the successive technical requirements: 1) monitor resolution of > 4 megapixel, 2) contrast ratio of > 3000 :1. As jpeg-compression is a flexible compression standard, standardized compression modes for all slide scanners should be implemented.

Quality management is a growing issue in pathology which in turn also acts as a quality control tool in medicine. This again requires a good quality control system within the quality management in pathology laboratories. To achieve this a thorough analysis of the main pillars of defined quality and so called products of pathology labs is the first step. Further analysis has to be made on potential errors and their sources. Upon this a quality management system can be constructed to minimize the frequency and severity of occurring errors. In our analysis we describe the potential errors within the workflow of a pathology laboratory and the use of virtual microscopy in a digital pathology lab which incorporates the analysis of virtual slides into a quality management and control system with automated recovery of errors and their correction.

Background: The development and implementation of virtual slide technology which is the transformation of complete glass slide images into a digitized matrix has left its childhood. So – called slide scanners of several companies are commercially available and already frequently used for various applications, especially education. What is the potential impact of this technology on tissue – based diagnosis (surgical diagnostic pathology)?
The scanning procedure is commonly based upon a patchwork system either in line or area attachment. An acquired image amounts several GB in size; the scanning time reaches 1 min/slide. Image handling and processing require specific software assistance that includes image compression, image notifications, and image analysis. In principle, virtual slides can be analyzed and interpreted by pathologists (human diagnosis), and/or by automated information detection systems (automated screening and diagnosis). Fast image transportation, individual image visualization adjusted to the individual pathologist, and high performance viewers contribute significantly to the pathologists’ acceptance of virtual slide diagnosis. They require algorithms that are different from automated diagnosis systems. Image quality analysis and standardization, search for the “significant areas of view,” automated magnification adjustment, as well as texture analysis, object segmentation and structure derivation are prerequisite for “automated diagnostic systems”. Although most of these compartments are already fully developed or in their test phases (see, for example www.diagomx.eu) general accepted standards are still missing for both human interaction or automated diagnosis. They still have to be implemented into the pathologists’ routine workflow.

Perspectives and conclusion: Image acquisition time and image size (compression, (distributed) storage, handling and transportation) are the main handicaps of virtual slide technology at present. The development of a new generation of faster scanners and algorithms for distributed (Grid embedded) image handling, and adequate image analysis systems will probably enhance the application of virtual slides (virtual microscopy) in routine diagnosis.

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The use of fixed image sizes is prerequisite for any texture analysis including area dependent image transformations.

Perspectives: The development and implementation of image standards focusing on specific needs of virtual microscopy is an issue that has to (and certainly will) become of significant attention in human and automated application.

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References

S14

Improved molecular read-out options via adequate tissue fixation

Dagmar Silvia Lang, Holger Schultz, Ekkehard Vollmer and Torsten Goldmann

Clinical and Experimental Pathology, Research Center Borstel, Borstel, Germany

E-mail: tgoldmann@rz-borstel.de

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The novel HOPE technique has proven to be an excellent tool for both research as well as diagnostic aspects. This presentation will focus on the advantages provided by this unique fixation technique as compared to formalin fixation as the current standard with regard to integrity as well as long-term preservation of both nucleic acids and antigenic structures.

A complete panel of modern molecular analyses are demonstrated, including DNA extraction, RT-PCR analysis, in situ hybridization, Northern–blot and Western–blot that has been successfully applied on human tissues of different organ origin. Clinical applications with regard to mechanisms of human lung infection (COPD) and Her-2 diagnostics for human breast cancer are also included. Furthermore, recent results are presented using an ex vivo short-term tissue culture model (STST) that has been established in combination with the HOPE-fixation method. This STST model is suitable not only as a promising model of the initial phase of lung infection, but has also considerably improved the possibilities to identify clinically relevant molecular targets for anticancer treatment of human lung cancer.

In conclusion, the HOPE-technique represents a valuable tool for extensive molecular analyses in human tissues, whereas STST represents a multifunctional ex vivo model for various aspects in clinical research and modern diagnostic pathology. In combination, a solid base is provided for the development of efficient High Troughput assays to further enhance the diagnostics in human severe disease.

S15

Changes of texture features due to image compression

Konradin Metze1, Randall L. Adam2 and Neucimar J. Leite2

1Working group “Analytical Cellular Pathology” and National Institute of Photonics Applied to Cell Biology, University of Campinas, Campinas, Brazil;
2Institute of Computing, University of Campinas, Campinas, Brazil

E-mail: kmetze@pq.cnpq.br

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Background: The digitalization of histologic or cytologic slides followed by computerized image analysis is becoming more popular due to technical advances in virtual microscopy and telemedicine. Because of the high information content of a digitalized slide, the application of compression methods is often a necessary step in order to reduce storage or bandwidth requirements, but image compression is usually accompanied by a loss of information.

Our aim was to investigate to which extent image compression according to the JPEG2000 standard is provoking alterations of image texture features.

Methods: For our study we used 8-bit-gray value bitmap images created “in silico” with defined complexity, i.e. predetermined fractal dimension of the...
A diagnostic decision support system (DDSS) is defined as a methodology that provides guidance in situations involving complex decision sequences. DDSSs result in a systematic, ordered, and exhaustive evaluation of evidence and weighting of individual items of evidence as they are combined to form the basis for a final decision. Most DDSSs provide a numeric measure of confidence in the final decision or diagnostic recommendation. The decisive advantage of DDSSs is the ability to process descriptive symbolic information, in contrast to systems limited to the handling of numerical information only for which extensive analytical procedures are already established. Most human knowledge and insight related to diagnostic and prognostic evaluation exist in symbolic form as concepts and linguistic terms, so the DDSSs have facilitated systematic evaluation of evidence to provide diagnostic and prognostic decision support.

DDSSs may be implemented as inference networks (or Bayesian Belief Networks — BBNs), automated reasoning systems, case-based reasoning systems, or expert systems. In inference networks and automated reasoning systems, the emphasis is on uncertainty assessment of a given decision sequence. In case-base reasoning, the emphasis is on prognostic assessment for an individual patient. In expert systems, the emphasis is on diagnostic or prognostic assessment, by making available a comprehensive knowledge base of facts and professional experience. However, even though the emphasis is slightly different in these kinds of decision support systems, much of the methodology is shared.

A BBN consists of a decision node for the diagnostic alternatives and evidence nodes for the diagnostic clues. Each clue is observed, rated, and assigned to a function with a given probability. The evidence is then forwarded to the decision node via a conditional probability link matrix. At the decision node, the belief in each diagnostic alternative is accumulated. A series of BBNs have already been successfully developed for prostate and non-prostate neoplasms (7-13) including comparing cancer with benign lesions and those with prostatic intra-epithelial neoplasms.

In today’s pathology lab, understanding and optimizing the workflow becomes more and more important. The integration of image analysis into the workflow requires special considerations for generating correct results. Currently, image analysis in pathology is used primarily for the quantification of IHC slides like Her2.

Pathology laboratories can choose from a number of image analysis systems which scan complete slides at different magnifications and generate virtual slides for review by pathologists. Pathologists can mark regions of interest on virtual slides for quantification. Specific algorithms can then be applied to each region, generating results/scores that are calculated for these regions. The resulting data is then, together with pre-selected images, compiled into a customizable report.

There are four key components for image analysis:

- Staining quality
- Image quality
- Algorithm
- Region selection

Staining quality can be improved through the use of automated staining with defined staining protocols. Additionally, linking specific pre-treatment, antibody, and staining protocols to an image algorithm is key for consistent results. Having consistent staining is necessary for successful image analysis because differences in staining lead to differences in acquired digital images thereby affecting image analysis. Image quality can be achieved through automation and calibration. Algorithms need to be specific to the antibody used to generate the appropriate results. Region selection relies on the pathologist’s expertise. Thus, image analysis is used as an aid to the pathologist.

A key component to image analysis is the integration of the image analysis system into the overall lab workflow. For example, Dako Link is used to connect different instruments in the IHC laboratory and to capture data from different steps in the slide preparation process, which are stored and can be retrieved. In this workflow, the first step is accessioning, where case information is captured together with the requested staining protocol. The automated staining instrument uses this information (including the antibody and the staining protocol) to stain the slide. The actual information for a specific slide is then stored. Once the slides are stained and ready, they are loaded onto the ACS® III, which accesses the Dako Link database and retrieves information about the slide. The information is then used to select the appropriate algorithm, which will be used to process regions on the slide.

By linking automated staining systems with image analysis systems, the user is not required to re-enter information and therefore the opportunity for errors is lowered, while at the same time it is guaranteed that the correct algorithm is used for the slide.

This concept could be used to connect other image analysis systems to laboratory workflow, improving overall workflow and reducing the number of opportunities for transcription and other errors.

In the future, digital pathology will include digitization of the complete workflow. Information will be generated in the lab, including staining information and digitization of the slide and the process will be completed by image analysis.

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S16 Automated decision algorithms in prostate cancer
Rodolfo Montironi
Institute of Pathological Anatomy and Histopathology, Polytechnic University of the Marche Region, United Hospitals, Torrette, Italy
E-mail: r.montironi@univpm.it
Diagnostic Pathology 2010, 5(Suppl 1):S16

A diagnostic decision support system (DDSS) is defined as a methodology that provides guidance in situations involving complex decision sequences. DDSSs result in a systematic, ordered, and exhaustive evaluation of evidence and weighting of individual items of evidence as they are combined to form the basis for a final decision. Most DDSSs provide a numeric measure of confidence in the final decision or diagnostic recommendation. The decisive advantage of DDSSs is the ability to process descriptive symbolic information, in contrast to systems limited to the handling of numerical information only for which extensive analytical procedures are already established. Most human knowledge and insight related to diagnostic and prognostic evaluation exist in symbolic form as concepts and linguistic terms, so the DDSSs have facilitated systematic evaluation of evidence to provide diagnostic and prognostic decision support.

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A BBN consists of a decision node for the diagnostic alternatives and evidence nodes for the diagnostic clues. Each clue is observed, rated, and assigned to a function with a given probability. The evidence is then forwarded to the decision node via a conditional probability link matrix. At the decision node, the belief in each diagnostic alternative is accumulated. A series of BBNs have already been successfully developed for prostate and non-prostate neoplasms (7-13) including comparing cancer with benign lesions and those with prostatic intra-epithelial neoplasms.

S18 Server-based teleconsultation in lung pathology
Sven Seiwerth, Gian Kayser, Adil Daubut, Lovorka Batelja, Luka Bracic and Klaus Kayser
Institute of Pathology School of Medicine Zagreb, Institute of Pathology, University Freiburg, Freiburg; UICC-TPCC Charite, Berlin, Germany
E-mail: sven.seiwerth@mef.hr
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Teleconsultation in pathology can be performed using different modes. We can choose between live or still image, between interactive and store and forward. Each of the proposed modalities has its pros and cons, depending on the application, needs and technical prerequisites we are dealing with. We can also use different platforms one of which is a server – based system. There are different elements influencing our choice. In most instances dealing with pathologists and/or expert consultation a store and forward, server-based approach has proven to be advantageous. Through this approach we can enable a relatively quick but user (consulting and consultant) friendly exchange of information. We established a teleconsultation project between the Institute of Pathology Zagreb, being the diagnostic base for the clinic for chest diseases, and the UICC_TPCC Charite Berlin. With years long experience in different approaches to
teleconsultation service both institutions engaged in the testing of an already operational server-based system (ISSA/Pharos). This system serves as both, a patient database and a teleconsultation tool enabling storage and exchange of all patient data, including images of different origin. We tested the system on different types of biopsies, especially on bronchoscopy specimens. The system consists of two parts – the ISSA system is a server – based patient database allowing storage and access of all patient data, including images. The data can be accessed either by random search descriptors, by name or ID number. In the teleconsultation process the whole patient file is transferred, via internet, to the consultant. This, in turn opens the file, reviews the images an writes his opinion in the adequate space. By returning the exam the consultation automatically appears in the patient file of the requesting pathologist. This mode of operation is time-preserving, reliable and secure, adding up to the quality of diagnosis.

Several years ago the idea of placing the databank in the center of telemedeval endeavor seemed quite unorthodox. Databases or image databanks were designed to enable the storage of patient images in the beginning from one type and later from different sources. With time the idea evolved that modern concepts should not only be limited to image storage and retrieval but enable the storage of all relevant digital or non-digital information needed for patient diagnosis, treatment, follow-up or consultation as well as for later statistical or epidemiological evaluation. The introduction of CMIS (Clinical Image Management Systems) a tool is created, which combines patient demographic data, clinical data, examination data as well as images collected in examinations. In this way electronic patient records are created. In telemedicine application electronic patient records can be moved from point to point in medical service workflow. Following this idea databases are created containing integrative patient records instead of respective examination data. These databases also should allow easy data transfer via Internet or some other means. All the data must be stored safely, and allow stable retrieval. Compliance of such databases to standards (such as DICOM) is mandatory. The evolution of this idea can be followed trough the evolution of the database ISSA and telemedicine system Pharos (VAMSTech, Zagreb). They developed from two separate entities with the possibility of exchanging data and images to an integrated system where each element can be run individually or the telemedicine part can be used as a transfer tool serving the database. We can say that the database moved to the coast of the communication sea. A logical step further was to immerse it into the sea. It was done by introducing a web server (ISSA Web server) allowing for creation of patient databases which can then be accessed from any computer linked to the Internet. So now we have a vast number of options how to proceed with our patient integrative record. We can transfer our patient record, containing all data, point to point (using ISSA-Pharos system) or put it on the ISSA Web server (for consultation) or mail it as e-mail attachment (to the family doctor) or put it on a CD (which the patient can car with him). A few years ago The Croatian telemedicine server moved from the TELECOM to the Medical Faculty University of Zagreb and its new address is: telemed.med.hr.

Results: Overall, 92% concordance rate has been achieved on practical examination based on 50 virtual slides pro every student connected with 50 multi-choice test questions. On-line teaching and on-line practical examination was evaluated through students' responses to the questionnaire-based evaluation. After completion courses and passing on-line practical examination in 2005/06, 2006/07, 2007/08 and 2008/09 all dental students of the third term at the Medical University of Poznan were asked to fill an survey to evaluate their acceptance of Webmicroscope. Students were asked to complete forms after their examination and full anonymization of data was guaranteed. Responses were evaluated on a standardized scale. A high response rate was achieved (99%). Satisfaction surveys showed progressive improvement over the past 4 years, as various suggestions were implemented. Webmicroscope as didactic tool during laboratories was rated 8.4 in 2004/05 and 9.4 in 2007/08 in scale 1-10. All students preferred the on-line examination over a traditional microscope and paper-and-pencil examination and all felt that the quality of digitized slides was superior to make an accurate diagnosis (rating 9.5 in scale 1-10).

Results: With current technology digital slides are technically feasible and virtual microscope is available at any time and any place via broadband Internet. Dental students have not only accepted this technology but have indicated enthusiasm for the development of further on-line teaching resources in pathology. Because our Webmicroscope provides the convenience of a Web-based resource with high-quality images we believe that viewing whole slides on this way adds a totally different dimension in teaching pathology. It is allows students to explore slides at any area and any magnification and independently identify and discover pathological changes.

### S20

**Facilities of a novel tissue fixation method: the HOPE-technology**  
Ekkehard Vollmer, Holger Schultz, Dagmar Silvia Lang, Daniel Kähler, Florian Stellmacher and Torsten Goldmann  
Clinical and Experimental Pathology, Research Center Borstel, Germany  
E-mail: tgoldmann@fz-borstel.de  
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We introduced an alternative and novel tissue fixative and compared it to conventional formalin fixation. Besides different stains used in routine diagnostics including histochemistry as well as immunohistochemistry we focused on molecular pathology. The latter gives many obstacles when using formalin fixed paraffin embedded tissue (FFPET), and many of the modern molecular techniques can even only be achieved on fresh or frozen specimens in the past and not on FFPET. In our repertoire many common molecular biological techniques on the nucleic acid level (RNA and/or DNA) of HOPE fixed and paraffin embedded tissues were compared to formalin fixation as well as to fresh and/or frozen material.

As a summary we have shown that the HOPE technique results in a comparable morphological preservation to formalin fixation (up till now for more than ten years experience); furthermore that DNA, RNA and proteins are protected. Thus the HOPE technique permits a succesfull application of all molecular techniques such as in situ hybridization targeting either DNA or RNA, immunohistochemistry without antigen retrieval and for formalin-refractory antigens, PCR, RT-PCR, Western blot, Northern blot, and transcription microarrays etc.  
Taken together, the HOPE technique to date represents the best alternative fixation that is well applicable to tissue specimens by preserving an excellent morphology in contrary to other procedures, and is well documented and broadly scientifically analyzed. Therefore by the HOPE-technology new possibilities are opened up especially within the rapidly growing field of molecular pathology.

### S21

**Network for whole slide imaging (WSI) clinical usage**  
Yukako Yagi  
Department of Pathology, Harvard Medical School, Boston, MA, USA  
E-mail: yyagi@partners.org  
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**Background:** IT technologies are improving daily; at the same time, network security rules are becoming more complex. These factors make it more difficult to design an optimized WSI system and network.

### S19

**Four years experiences teaching pathology with the WebMicroscope to dental students**  
Janusz Szymas and Mikael Lundin  
Department of Clinical Pathology, University of Medical Sciences  
Pryzubysszewski Str. 49, 60-355 Poznan, Poland.  
Bimedical Informatics Research Group HUCH Clinical Research Institute, University of Helsinki  
P.O.Box 105, FIN-00290 Helsinki, Finland  
E-mail: jcszymas@ampat.amu.edu.pl  
Diagnostic Pathology 2010, 5(Suppl 1):S19

**Background:** We have developed and evaluated a user-friendly on-line interactive teaching and examination system for pathology. Since 2005 all laboratory lessons have moved to computer class-room. Traditional microscopes for students were replaced by computers and interactive sessions using Internet based WebMicroscope. By accessing full digitized slides on web with a browser and viewer plug-in, computer got perfectly companion of the students at all laboratories.

**Methods:** The study material consists of over 400 fully digitized slides which comprise 15 entities in basic pathology and 15 entities in oral pathology. Digitized slides are linked with still macro- and microscopic images, organized with clinical information into virtual cases and supplemented with text files, PowerPoint presentations and animations, serving additionally as self study material on the web.
Methods: Four different WSI systems were used and each had a different structure and a data format over the network. The standard PC in our department is Microsoft Windows XP Professional version 2002 Service Pack 3 and CPU is Intel Core 2 CPI 6300 1.86GHz with 1GB or 2GB of RAM. The network bandwidth is either 10, 100MB/s. The storage server is Quad-Core-2.33 GHz Zeon Processors, 18GB RAM, and STB SAS RAID array; OS is Windows 2003 server. All scanners are connected to the storage server by 1GB. 5 TB NAS is used to optimize storage capability.

We examined the network and GUI performance for different purposes under varying conditions. All viewers were an open HTTP message interface to enable client software to incrementally access image information and view data.

Images were located in the internal storage server, and in three outside servers. Screen resolution was 1280x1024 pixels. Basic viewer study, the time to data completion was measured at seven conditions. All data were an average of three measurements. JPEG 2000 performance was compared with JPEG. The time to complete the 3D model was measured. Nine of Multilayer Cytology specimen was used and compared comfortableness to view the multiple focus planes.

Results

• The amount of computer memory is more important than network speed when images are accessed externally via the internet. Computer memory is also more important when images are compressed with JPEG2000.

• Network speed is more important when images are accessed locally through the intranet and compressed with JPEG.

• An external hard drive could be useful. However, the particular network conjunctions still might affect the speed at which images could be accessed.

Conclusion: Our network conditions are not yet ideal for many reasons, including budgetary constraints, institutional policy, etc. The data we have been collecting will be very useful when we begin planning upgrades to our WSI network/server with out network specialist.

Cite abstracts in this supplement using the relevant abstract number, e.g.: Yukako Yagi. Network for whole slide imaging (WSI) clinical usage. Diagnostic Pathology 2010, 5(Suppl 1):S21.