

# Innovation in Transplantation: The Digital Era

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## Abstract

The international symposium entitled “Innovation in Transplantation: The Digital Era” took place on June 7 and 8, 2018 in Verona, Italy. This meeting was borne out of the productive collaboration between the Universities and Hospital Trusts of Verona and Padua in Italy, in the context of a vast regional project called Research and innovation project within the Health Technology Assessment. The project aimed to create an innovative digital platform for teleconsultation and delivering diagnostic second opinions in the field of organ transplantation within the Veneto region. This conference brought together pathologists, health informatics leaders, clinicians, researchers, vendors, and health-care planners from all around the globe. The symposium was conceived to promote the exchange of knowledge and kindle fertile discussion among the 130 attendees from 15 different countries. This article conveys the highlights of this symposium.

**Keywords:** Digital pathology, pathology informatics, telepathology, transplantation, whole-slide imaging

## INTRODUCTION

Many efforts are underway around the world aiming to pave the way for digital pathology to be incorporated into routine clinical practice. Indeed, the potential benefits for pathology by adopting digital technologies have been solidly established.<sup>[1-4]</sup> Digital pathology provides quick access to pathology cases, from anywhere in the world and at any time. The ease with which a pathologist or any health-care provider can view digitized slides affords many scenarios for its applicability, without compromising safety or quality.<sup>[5-8]</sup> Transplantation is a perfect niche in which digital pathology can improve clinical care. Requesting a diagnostic second opinion is a crucial moment during the transplantation process to procure organs and save a life. Padua and Verona are recognized medical centers of excellence engaged in the field of transplantation that exploit innovative technology.<sup>[9]</sup> This served as an ideal setting to host internationally recognized opinion leaders from around the world to converse about “Innovation in Transplantation” in “The Digital Era.” The symposium was borne out of the productive collaboration between the Hospital Trusts of Padua and Verona, in the context of a more vast regional project called Research and innovation project within the Health Technology Assessment. The “Transplant Telepathology Net: Diagnostic Oncological Platform and Quality Organ Assessment” project

was charged to create an innovative digital platform for teleconsultation and diagnostic second opinions in the field of organ transplantation in the Veneto region of Italy.

## MEETING OVERVIEW

The international symposium “Innovation in Transplantation: The Digital Era” took place on June 7 and 8, 2018 at the Verità-Poeta Palace [Figure 1] in Verona, Italy. The meeting was the result of a productive collaboration between the Universities and Hospital Trusts of Verona and Padua. The symposium was conceived to promote the exchange of knowledge and kindle fertile discussion among the 130 attendees from 15 different countries. Participating health-care representatives were mainly represented by pathologists. However, health informatics leaders, clinicians, researchers, managers, laboratory technicians, and information technology staff and vendors contributed to a substantial number of the attendees [Figures 2 and 3].

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**Figure 1:** Stage and main meeting room at Verità-Poeta Palace



**Figure 2:** Attendees and faculty in the courtyard



**Figure 3:** Verità-Poeta Palace seen from the courtyard

The symposium was divided into five scientific sessions with invited talks forming the backbone of the program. The titles of the sessions were as follows: (session 1) Organ transplantation – past, present, and projects, (session 2) Role

of pathology – risk stratification and quality assessment of the donor, (session 3) Imaging for clinical practice, (session 4) Digital pathology resources and guides, and (session 5) Transplantation and networks. The symposium started with an opening lecture entitled “Diagnostic consultation for clinical care” delivered by Prof. Angelo Paolo Dei Tos from Padua University, Italy, and ended with a final lecture entitled “The emerging world of enterprise imaging and its impact on pathology” provided by Prof. Liron Pantanowitz from the University of Pittsburgh Medical Center (UPMC), Pittsburgh, USA.

## **SPEAKER CONTRIBUTIONS**

### **Session 1: Organ transplantation: Past, present, and projects**

Dr. Giuseppe Feltrin, coordinator of the Veneto Regional Transplantation Center, provided a comprehensive overview of the current state-of-the-art of transplantation activity in the Northeastern Veneto region of Italy.

Key point – The transplantation field is constantly changing with significant impact to the health-care system.

Dr. Luigino Boschiero, Chief of the Kidney Transplant Unit in Verona Hospital Trust, Italy, summed up the past 40 years of renal transplantation including its clinical and technical evolution, with a focus on local-grown expertise.

Key point – Kidney transplantation is a field where clinical and technical evolution has grown the most.

Dr. Valter Pagani, from the EucGroup in Bruxelles, Belgium, discussed his perspective on the importance of planning and designing a winning project in a health-care system, with particular attention to opportunities for European Union facilities.

Key point – A winning project needs careful management to ensure successful implementation, measurement of desired effects, as well as appropriate allocation of resources and dedicated personnel.

Dr. Filippo Fraggetta from Cannizzaro Hospital in Catania, Italy, demonstrated the potential of applying whole-slide imaging to routine, daily clinical practice based upon his personal, institutional experience.

Key point – Digital pathology is easy and safe to use in the pathology laboratory for daily surgical pathology practice.

Prof. Ugo Boggi, Chief of Surgery at Pisa University Hospital, Italy, presented the past, present, and future issues relevant to the field of pancreas transplantation.

Key point – A medical center’s volume of transplant procedures and expertise are crucial for successful outcome in pancreas transplantation.

### **Session 2: Role of pathology – Risk stratification and quality assessment of the donor**

Dr. Alessandro Nanni Costa, Chief of the Italian National Transplantation Center, provided a comprehensive talk on



issues related to safety and innovation associated with previous activity of the Italian transplantation net.

Key point – Organ procurement from donors with a history of a neoplasm is safe when meticulous donor assessment is undertaken according to the established guidelines.

Prof. Matteo Brunelli from the University and Hospital Trust of Verona, Italy, described the main scenarios on reporting malignancy during donor quality assessment from a pathologists' point of view.

Key point – The main issue for pathologists to address at the time of transplantation is to establish the risk of a lesion being discovered in a donor. Furthermore, it was recommended that the current terminology employed in the scenario of donor assessment must be revised.

Prof. Antonia D'Errico from the Italian National Second Opinion for donor safety spoke about the importance of quality and safety matters in transplantation, providing insight from national and international experiences.

Key point – Second opinion activity increases procurement and allocation of organs from donors with neoplasia.

Dr. Desley Neil, a pathologist from the University Hospitals Birmingham, UK, summed up kidney organ assessment for transplantation and reviewed the limitations of associated procedures.

Key point – Different scoring systems for kidney transplantation are used worldwide; there is accordingly a need for standardization and the establishment of new cutoffs. Digital pathology was advocated to be used for this process.

Dr. Claudia Mescoli, a pathologist from Padua University Hospital, Italy, reviewed the topic of liver organ assessment for transplantation including limitations of related procedures.

Key point – While biopsy remains the gold standard for liver transplantation, there is still poor agreement related to the quantification of steatosis.

### Session 3: Imaging for clinical practice

Dr. Claudio Saccavini from Treviso Hospital, Italy, compared digital pathology to experiences of radiology services in the application and daily usage of digital imaging systems.

Key point – Much can be learned from the experience of radiology when it comes to digital images, especially with regard to image sharing, communication systems, and clinical applications.

Dr. Arrigo Capitanio, a pathologist from the University Hospital Linköping in Sweden, reported on his experience with a fully implemented digital pathology practice that used whole-slide imaging for everyday practice.

Key point – Digital pathology is not only reliable for routine diagnosis but also has great potential for education, research, and quality assessment purposes.

Prof. Anil Parwani from Ohio State University Medical Center, USA, discussed the key aspects, advantages, and possible disadvantages of fully implementing whole-slide imaging for clinical diagnostic work.

Key point – Whole-slide imaging system implementation offers great opportunities for the reorganization of workflow in the laboratory, training pathologists to use digital images, teleconsultation, and building a large database of digital slides for research and deep learning.

Prof. Toby Cornish, a pathologist from the University of Colorado, USA, gave the audience a stimulating talk about the legal and regulatory aspects of telepathology, mainly from the USA law perspective.

Key point – The legal aspects of digital pathology systems that affect manufacturers and health-care institutions are different in Europe and the United States, which must be kept in mind when designing projects or embarking on large collaborations.

### Session 4: Digital pathology resources and guides

Prof. Vincenzo Della Mea from the University of Udine, Italy, shared his experience with the 2016 International School on Digital Pathology held in Aviano, Veneto, and emphasized the involvement of nonmedical health-care personnel and relying on continuous feedback to improve such training.

Key point – Digital pathology can be used with positive results to training not only pathologists but also other nonmedical health-care workers and scientists with an interest in digital imaging.

Dr. Keith Kaplan, the former director of the Armed Forces Institute of Pathology army telepathology program, USA, deliberated on how artificial intelligence (AI) may affect health care, particularly in the field of pathology.

Key point – AI in the near future is likely to definitely help pathologists but will not replace them.

Dr. Marcial Garcia Rojo from the University Hospital Cadiz, Spain, gave an overview about standardization of a digital pathology system, from the time of specimen receiving to final digital slide viewing and archiving.

Key point – If going digital is of paramount importance in pathology, then we need to agree on standardizing the different commercial digital viewing and archiving systems.

Prof. Liron Pantanowitz from the UPMC, USA, reviewed the guidelines from the College of American Pathologists for validating whole-slide imaging for diagnostic purposes and discussed key factors to be considered in the updated version of these recommendations.

Key point – Increasing experience and published data support the use of whole-slide imaging, but clinical validation is still required for intended clinical uses. Guidelines about validation promote safety and standardization but need to be updated regularly to remain helpful in practice.

## Session 5: Transplantation and network

Prof. Anthony Demetris from the UPMC, USA, summarized important scientific milestones in transplantation pathology, with a focus on graft rejection and the important contribution of digital pathology to this field.

Key point – Digital pathology is a powerful tool to accurately evaluate important morphological and immunohistochemical parameters in graft rejection biopsies; transplant pathologists will need to accordingly learn how to apply this technology in their own practice settings.

Prof. Mauro Truini, president of the Italian Society of Pathology (SIAPEC), gave the audience a talk about the importance and role of scientific societies and colleges to promote innovation and education, during which he presented some recent Italian examples of digital technology applications.

Key point – Scientific societies play an important role in promoting digital pathology, by endorsing its advantages, guiding pathologists on best practices, and ameliorating system performance concerns by recommending validation studies.

Dr. Rosa Liotta from the Mediterranean Transplant Institute (ISMETT) in Palermo, Italy, shared her experience of the collaboration between ISMETT and UPMC in Pittsburgh, USA, made possible by implementing telepathology.

Key point – Exploiting telepathology over the past 20 years has allowed ISMETT to remain at the cutting edge in pathology by being able to seek valuable help from international experts for difficult cases.

Prof. James Crawford from North Shore University Hospital in New York, USA, presented his experience of using telepathology as a consultation tool for frozen sections in the setting of a multicenter health-care service comprised of many affiliated hospitals.

Key point – Investing in and validating digital pathology for intraoperative consultation of frozen sections in a large multicenter health-care system has been advantageous in terms of efficacy for remotely delivering expert patient care.

Prof. Marta Minervini from UPMC in Pittsburgh, USA, communicated the results from 10 years of experience using whole-slide imaging for kidney and liver frozen section biopsies employed in organ assessment for transplantation.

Key point – Whole-slide imaging for frozen section biopsies has proven to be reliable in organ assessment for transplantation and after full implementation at UPMC for this purpose helped reduce overall costs, improved diagnostic accuracy, and established a network of experts in the field.

Prof. Dorry Segev from John Hopkins University, Baltimore, USA, discussed the importance of mentorship for young health-care providers in the field of transplantation.

Key point – In a team of different specialists, a mentor should lead everyone to do what he/she does best to help grow the entire team.

## DISCUSSION

The meeting successfully brought together experts from two different fields of pathology which have both increased in importance over recent years: transplantation and digital pathology. Results of the meeting are summarized in Table 1. As many of the speakers explained, there is a global upsurge in transplantation activity that has required health-care systems and pathologists to respond to this increasing demand. The overarching message of the conference was that digital pathology can play an important role in addressing some of these needs (e.g., telepathology and image analysis) and at the same time can advance the field of transplantation. In digital pathology, there have been considerable technological advances that have permitted these imaging systems to be effectively used in daily clinical practice and for cutting-edge research. Several of the speakers corroborated this message by sharing their personal experience, demonstrating the reliability and safety of whole-slide imaging for routine diagnostic practice. Given the benefit of having immediate access to an expert second opinion, some of the speakers pointed out that teleconsultation for frozen section during transplantation is a perfect application of digital pathology. However, issues that still need to be tackled include cost, legal questions, lack of training, and complex workflow in laboratories. Moreover, digital pathology can also be leveraged to advance the field of transplantation by promoting standardization, protocols, guidelines, and further research. The take-home message from the conference was that we can anticipate exciting times in the next few years as these two fields of pathology continue to grow and complement each other.

**Table 1: Innovation in transplantation: The Digital Era - Meeting results**

Strengths and evidence
Digital pathology is appropriate and accurate in transplantation
Expertise in reporting and application is consistent in different settings
Network of skills and technology as the key for second opinion activity
Limitations and barriers
Technical issues in implementation of complete digital systems
No standardization of applications and terminology compared to traditional histology
Lack of propensity to change
Cost issues and medicolegal differences
Future directions
Need for even more technological development
Need for standardization and consensus on applications of digital
New generations of pathologists committed and trained to use digital
Promoting leadership on transplantation activities at any level
Networking for financial support and international grant

## CONCLUSION

The international symposium “Innovation in Transplantation: The Digital Era” was one of the first meetings that successfully brought together recognized experts in the fields of digital pathology and transplantation.

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## Conflicts of interest

There are no conflicts of interest.

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