

# Modern advancements in histopathological diagnosis: A mini review

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## Abstract

Histopathological diagnosis has dramatically improved with the advent of telepathology. The use of smartphones with WhatsApp application has become a useful tool in diagnostic and research pathology. Machine learning will emerge as the future of health care as disease prediction models can diagnose flawlessly and systematically approach the therapeutics. This will open up new avenues for computational exploration of a disease process and may get integrated into mainstream diagnostic histopathology in the near future. This review discusses about the modern advancements in histopathological diagnosis in the recent years.

## Introduction

Histopathology is a specialized branch of medicine, where microscopic examination of diseased tissues forms the cornerstone inadequate diagnosis.<sup>[1]</sup> Sometimes, diagnostic dilemmas arise during reporting of complex cases, and a pathologist would like to consider the opinion of another pathologist or a panel of pathologists to arrive at a definite diagnosis. Exchange of tissue blocks and stained slides too far off places for the second opinion was a cumbersome process and resulted in delayed diagnosis.<sup>[2]</sup> In the current area of modern technological advances such as telepathology, three-dimensional image technology, and automated machine vision systems are gaining popularity as it is quick, easy, reliable, and cost-effective.<sup>3</sup> In developing countries like India, many health centers and hospitals do not have an in-house pathologist. A distant pathologist can help with primary diagnosis in these cases, and it is convenient as it does not require the patient's presence. Photographic images depict the actual appearances of the pathological changes which will reduce the inaccuracies or subjective bias that result from variations in descriptive ability. The goal is to fasten the diagnosis, assisting in patient care, better prognosis, rehabilitation, monitoring, follow-up, and also for medicolegal purposes.<sup>[3]</sup>

## Telepathology

Telepathology is a branch of telemedicine, where medical/pathological data are transferred from one site to another through telecommunications for diagnosis that would reflect inadequate treatment as well as research purposes.<sup>[4]</sup> The term, “telepathology” was coined in 1986 by pathologist Ronald S Weinstein and is known as “father of telepathology.” He and his collaborators published scientific papers on robotic telepathology systems and telepathology diagnostic networks which were patented later.<sup>[5]</sup> Telepathology largely relies on the image quality, good internet facility, hardware selection, and information technology. It uses various forms of telecommunication technologies such as two-way videos (Skype, Facetime), e-mails, and smartphones. It requires a good camera system that can capture photomicrographic images (at different magnifications), store them and has a method to view and send images to far off places. Handheld cameras or smartphones can be used to click images. Cameras with charged coupled device image sensors are used in medical and scientific fields where high-quality image data are required.<sup>[6]</sup> Adaptors attach the cameras to microscope and are capable of single snapshot picture or video moving images. Whole-slide image devices have the ability to scan and give a picture of an entire pathology slide.<sup>[5,7]</sup>

## Smartphones

Smartphones have been introduced in the recent years and are used by people to communicate to one another. These smartphones have extremely sophisticated efficient cameras that have the ability to capture good quality clinical, radiographic, and histopathological photographs. Several helpline numbers are given by government and health organizations where patients can send their queries/photographs of the lesion for an opinion.<sup>[2]</sup>

One of the most advanced technological innovations is instant messaging services such as Google Allo and Facebook messenger, but the most popular one is WhatsApp messenger. These are cross-platform mobile messaging application that uses internet connection and allows users to exchange messages, images, audios, or videos. Facilities such as “group chat” and “broadcast” facilities are available where a panel of specialists can view all the patient information and have a discussion, concluding on the diagnosis early. Thus, the time required for obtaining the second opinion can be reduced in comparison with the conventional method. This reduces the delay and costs too.<sup>[2,8]</sup>

Numerous studies were conducted to evaluate the effectiveness of smartphones in medical field wrt sharing of images, online consultations, and second opinions. Petruzzi and De Benedittis conducted a study using WhatsApp as a telemedicine medium for oral clinical examination in remote areas and got good results.<sup>[9]</sup> While Zotti *et al.* through his studies suggested WhatsApp helped improve the oral hygiene compliance in adolescent orthodontic patients.<sup>[10]</sup> Torres-Pereira *et al.* conducted studies that suggested WhatsApp is an effective alternative that can increase consultation accuracy in distant diagnosis.<sup>[11]</sup> Sarode *et al.* suggested that it is an effective medium to arrive at diagnosis in oral pathology cases, as most pathologists found no difficulties in photomicrograph interpretation of images sent through WhatsApp.<sup>[2]</sup> Ramdurg *et al.* concluded that for specialist consultation in remote areas, teledentistry through smartphone is effective.<sup>[12]</sup>

It is feasible to click good images from any binocular microscope using smartphones. Currently, they come with a minimum configuration of 5-megapixel lens, resolution of 640 × 960 pixels, 5 × zoom, high dynamic range facility, and autofocus. High speed internet with 3G/4G facility is also required for exchange of images. This provides affordable and convenient mode of procuring the second opinion on histopathological diagnosis.<sup>[2]</sup>

It is important to educate and guide the information technology staff of the pathology laboratories or health sectors to ensure that adequate steps be taken during the transfer of information. The information should be secure and confidential.<sup>[13]</sup>

## Machine Learning

New technologies in machine learning can be used in future as part of diagnostics and research. Machine learning algorithms

are basically computer programs that can use gene expression levels available from patients to predict the stage/grade/behavior/incidence/prognosis of the disease based on past results. This will ease the work of the treating physician to predict the disease outcome and plan treatment. Etiological factors such as family history, age/sex/weight of the patient, food habits/lifestyle, exposure to carcinogens, and histological/immunohistochemical/molecular biomarkers play an important role in disease prediction. Risk assessment model can classify the disease, predict the susceptibility, recurrence, and survival rate in that particular disease.<sup>[14-16]</sup>

## Drawbacks of Telepathology

Clinicians need to accept and trust the diagnosis based on telepathology. There should be mutual understanding among pathologists to share knowledge and provide inputs. Acknowledgments and remuneration should be discussed priory. Other legal issues include data protection, licensing issues, and consent rules, especially for international projects. These recent advancements are mostly technologic and need to be user friendly. Acceptance and improvisation are required.<sup>[2,6]</sup>

## Conclusion

Modern advancements in histopathology have revolutionized diagnosis, and it promises to open new avenues for understanding of disease. This can facilitate interactions between the doctor and the patient and among pathologists providing faster communication. Thereby, transforming older conventional practice, to obtain accurate and swift management of pathologies. Future smartphones with latest versions of camera will provide greater clarity and details aiding in more accurate diagnosis. Further studies are recommended to bring more advancement in future prospects in histopathology.

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