Telepathology for effective healthcare in developing nations

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REVIEW

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Abstract

Telepathology has grown immensely due to rapid advances in information and technology. It has a wide variety of applications especially in the developing world, namely for remote primary diagnosis, specialist referrals, secondary opinions, remote teachings and in research.   Basic infrastructure and skilled and experienced staff are the prerequisites for its successful implementation.

Socio-economic differences in developing nations result in a chaotic scenario so that, the advanced areas have expertise, while rural and remote areas remain deprived. Telepathology has the potential to bridge this gap.

This article discusses how successful use of the internet for telepathology is bridging this gap in developing nations and thereby contributing positively to effective healthcare. Possible constraints to telepathology and some solutions to overcome them are also discussed.

Key Words: Internet, Healthcare, Telepathology, Telereporting, Developing nations

The internet is a global cooperative network of government, corporate, university and private computers, all collaborating and communicating with each other so as to shape the healthcare scenario today and define the world of tomorrow.

The term "telepathology" was coined in 1986 by a pathologist Dr Ronald S. Weinstein, who is also known as the "father of telepathology".[1]

Providing pathology services from a distance using advances in the internet and its applications in telecommunications is known as telepathology. Unlike routine pathology practice wherein the images are viewed directly through a microscope, in telepathology the images are viewed on a high resolution computer screen.[2-5]

The basic requirements for telepathology are:
1. a microscope (motorised for dynamic telepathology);
2. a high-resolution camera with a frame grabber card;
3. internet access; and
4. a telepathology workstation.

Types of telepathology[2,3]

Static telepathology – also known as 'store and forward' is an approach in which a section of slide is selected under microscope, its image acquired, stored and then all the relevant images are sent to the consultation centre via the internet. Proper histopathological diagnosis is possible only if the selected digital images are from the region of abnormality. Thus there is a possibility that results might be negative even if the slides have pathology if the digital image is not obtained from a truly representative portion. Hence the person who would be selecting the region to be imaged has to be trained or skilled in identifying the region of interest. In underdeveloped nations where there is a dearth of trained pathologists, it is the semi-skilled laboratory technician, who has undergone some training in recognising suspicious areas on the slide; who is responsible for this selection. It is however better to have at least trained medical graduates if not general pathologists to do the selection.

Dynamic telepathology – in which rapid virtual slide processing is undertaken. Ultra-rapid virtual slide processing[4] is very expensive.

Hybrid telepathology[6] – is a web and email-based system and is a mix of static as well as dynamic telepathology.

Image compression and the internet mode of transmission will not hamper the quality of images if the image is properly chosen from an adequately stained good slide. Use of adaptive colour reduction algorithms to reduce image file size, helps this transfer without sacrificing quality for a successful telepathology diagnosis. [7]

Applications of telepathology:

1. For primary consultation of cytology or histopathology specimen – this could be in the pre-operative or post-operative stage.

2. For secondary opinion in difficult or ambiguous cases.

3. For intraoperative consultation e.g. frozen section analysis to decide the extent of surgery. This requires dynamic telepathology and is currently only available in developed nations[5, 8] primarily because of the high costs involved.

4. Retro consultation – pathologists in developed nations who have an excessive workload and get lucrative payments for their opinion, accept all specimens and outsource them to pathologists in developing nations at a lesser pay package, who work on the material and send reports to the original pathologist in the developed nation. This report is then modified and signed by the pathologist in the developed nation. The process enriches both teams; provided legal issues concerning appropriate practice and licensing are addressed. This trend is especially seen in teleradiology.[9]

5. For preparing a worldwide knowledge database.

6. For teleconferencing various softwares available on the web. ImageScope[10] is high-performance software for viewing digital slides created by the ScanScope slide scanner.

It has tremendous advantages such as:

- Instant pan and zoom facility to any region and magnification of a multi-gigabyte digital slide.
- Viewing of multiple digital slides concurrently in synchronized windows.
- Applying image enhancements, in real-time, for contrast, brightness and gamma.
- Integration with Aperio software for remote viewing, authoring annotations, digital slide conferencing, and image analysis.
- Using the Image Quality (IQ) feature to optimize the appearance of your digital slides based on their staining.
- Using the annotations summary view window to perform quick and easy analysis of IHC digital slides.

- Enables the recording and replaying of tracks showing your movement through a digital slide.

Digital Slide Conferencing[10] using ImageScope enables multiple parties to simultaneously and synchronously view an image from anywhere. With ImageScope and an internet connection, users can connect to an Aperio DSC server to create a conference session or join an existing session. The ImageScope standard tools are available during digital slide conferencing, allowing for easier collaboration between remote users. Users can take turns controlling the session; assigning, relinquishing or requesting the conference lead.

7. For reference during reporting[11] – due to oceanic information on surgical pathology, the pathologists rely on user-friendly and quick information sources to find details during daily reporting. Due to its speed and advanced searching capabilities; the internet is gradually replacing the dependence on printed textbooks for reference.

Analyses of some telepathology sites

1. Telepathology on the Solomon Islands[6, 12]

The National Referral Hospital in Honiara, Solomon Islands, has used an internet-based system in Switzerland for telepathology consultations since September 2001. They employed iPath; a hybrid web and email-based telemedicine system developed at the University of Basel[12] to perform 333 consultations over two years in which 94% of cases could be diagnosed by a remote pathologist. A computer-assisted 'virtual institute' of pathologists was established. This reduced the median time from submission of the request to a report from 28 hours to 8.5 hours for a preliminary diagnosis and 13 hours for a final report. A final report was possible in 77% of all submitted cases.

2. Telepathology in Bangladesh[13]

I-Path, a group of pathologists from the University of Basel also covered the request for a second opinion from the Department of Pathology University of Dhaka, Bangladesh from the beginning of 2002 and gave satisfactory results at an affordable cost.

3. Telepathology in Cambodia[13]

This was started by DIAGAID a Thai – German group of pathologists established in 2002 at Sihanouk Hospital Center of Hope (SHCH) in Phnom Penh.

4. Telepathology in India

This has grown rapidly due to growth in the information and technology sector and widespread availability of the

internet. A static telepathology link was established between urban Mumbai's Tata Memorial Hospital and a rural-based Nargis Dutt Memorial Cancer Hospital, from 2000 onwards.[14] Of the 299 static telepathology consultations in a period of three years up to December 2004, concordance for tele-surgical pathology was 96%; 48% of cases were reported within eight hours (a single working day) and 91% of cases within three days.

Digital slide conferencing [15]

In India telepathology is even being used for pre-conference displays of pathology slides so that participants can be thorough during the discussions in lectures. A programme for continuation of medical education has even used digital imaging in pathology successfully. [15] This technique breaks the tie between glass slide and light microscopy, leading to instant communication. The digitalised glass slides were presented to enable virtual slide sharing during sessions of interesting case discussions.

Cost-related Issues

As of now in India, specialised oncopathology reporting is not yet available at all hospitals. Although such hospitals operate and even administer chemotherapy in oncology patients, they lack adequate back-up needed to report such specimens by trained oncopathologists. In such situations, slides from all over India are couriered to Mumbai's Tata Memorial Hospital. In many instances, the reports are often delayed due to the transit time involved and also due to the fact that sometimes they might get broken during transportation. Implementation of telepathology in such scenarios can be cost effective for either sides and can heavily reduce the precious time lost in transit.

Usage of telepathology reduces the cost of getting a slide reported from a specialist by 75% once the initial expenses of creating a adequate set-up at either end is met or broken even. Like in India, in many developing nations the service provider need not get the user to buy this facility because it is the other way round. As the service providers are in great demand, all users flock to them and are more than willing to get their timely and skilled services.

However, dynamic telepathology has more limitations, as it has to be accomplished between centres using the same operating system (software). The installation cost of the equipment and the computer programmes is between US$20,000 and $100,000 and they are affordable only by large hospitals and/or academic institutions. On the contrary the actual cost of a good high-resolution digital camera is between US$5,000 and $10,000 . Hence it is necessary that costs of telepathology equipment and telecommunication are lowered to reflect the current and affordable cost, only then would telepathology become the favoured option because it can be an economic mode of providing pathology services to a remote site.

Limiting factors for telepathology in developing nations

1. Lack of infrastructure due to economical constraints.
2. Lack of dedicated manpower.
3. Lack of incentives.
4. Substandard processing of material due to absence of quality standards in image processing.
5. Absence of quality control in the preanalytic, analytic, and post analytic phases.
6. Lack of peer-reviewed proficiency programmes such as the Australian slide club.
7. Absence of a laboratory information system.

Suggestions for fruitful telepathology services

Local government should encourage these efforts directly or indirectly. Direct financial assistance or provision of infrastructure would be highly encouraging. Indirect assistance in the form of certain subsidies and quick processing of official paperwork would also be heart lifting.

National and international scientific bodies and various pathology associations can also pool their resources to improve pathology healthcare services in regions of dire need.

Summary

Telepathology – a wonderful gift for effective healthcare has materialised only because of advances in information technology, namely the internet. It has the potential to provide satisfactory diagnosis even in the most remote places and thereby help alleviate the sufferings of mankind. Hence a positive impetus from local government and national and international scientific bodies is required especially in regions where pathology services are scarce and most needed.

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