Cancerworld

Telemedicine and diagnosis

Adriana Albini / 27 September 2022

The adoption of telemedicine and its range of applications grew exponentially in the early days of the Covid-19 pandemic, and the general consensus now is that it is here to stay, albeit perhaps with a more hybrid bias of in-person and remote visits. Telediagnosis, or TeleDx, i.e., the identification of a disease at a site remote from the patient, has expanded to include primary care, revolutionising the way in which patients and doctors communicate with each other and establish rapport. It is still early days to fully evaluate the effect of virtual vs in-person visit on diagnostic error, but there are guidelines for health professionals to conduct effective virtual examinations, and many best practice examples, both in terms of ways to gather information from the patient (from wording of questionnaires to digital records, home environment, and so on) and technological innovations.

In cancer care, **pathology** plays a central role in the final diagnosis upon which clinicians will develop treatment for their patient, and remote pathology can offer many advantages, such as easier access to pathology experts, consultation among specialists, timely and secure availability of images, and so on. Up until the 1990s, pathologists worked almost entirely within the constraints of the analogue world, with physical glass slides and microscopes. Some attempts were made at capturing virtual images of slides through a tiling method, which was time consuming and prone to error, as it required accurate placing and extensive stitching together of images. But at the end of that decade, engineer Dirk G. Soenksen (founder, and CEO of Aperio) devised a much more efficient system based on a linear scanner, the ScanScope, that allowed for tightly focussed and fast slide image capture, opening a new era for the practice of pathology. Whole slide imaging, or WSI, was first employed in education and research but in recent years, with the improvement of its technology, it has received regulatory approval by the FDA and around the world for diagnostic use as well. The potential for feeding AI algorithms to provide diagnostical support is massive, as virtual slides are accumulating fast and standardised databases are being built.

“Telemedicine in Cancer Care Continuum: implementation and integration”, was an online conference developed by the SPCC in collaboration with the American Society of Clinical Oncology (ASCO), which took place on 6-7 May 2022. In his presentation, **Liron Pantanowitz**, Professor of Pathology, and Director of Anatomical Pathology at the University of Michigan, talked about **telepathology in both its non-acute and acute settings**, focussing more extensively on the latter. The term ‘telepathology’ was coined by Ronald S. Weinstein in 1986, after he organised the first public event of satellite-enabled dynamic-robotic distant pathology, but the very first live

telepathology ever performed dates as far back as to 1968. Massachusetts General Hospital set up a two-way television link with Boston's Logan Airport that enabled doctors at the hospital to remotely study blood smears, urine samples and X-rays for patients at the airport, and even listen to their heartbeat with an electronic stethoscope. However, as in the case of telehealth in general, the adoption of digital pathology had to wait until the Covid-19 pandemic to be widely implemented. To facilitate continuity of healthcare while social distancing, certain restrictions were lifted, such as CLIA in the US, allowing pathologists to work from home and sign out cases.

The first use of telepathology Prof. Pantanowitz looked at was for **frozen section** consultation. There are several challenges when a pathologist is asked to provide an intraoperative consultation. The pathology specimen is fresh, not easy to cut. The frozen section itself is difficult to prepare and is often filled with artifacts. These artifacts not only make it hard to read the glass slides but can compound the problem when using digital images. The turnaround time needs to be rapid. Usually, pathologists strive for less than 20 minutes to provide the surgeon with an answer. And they are under serious diagnostic pressure because if they get it wrong, it is difficult to reverse the surgical decision that has been made based on their diagnosis. Over the past 54 years different modes of practising telepathology have been developed. A pathologist on site can take static images, which is easy but too time-consuming. There is also video microscopy, live streaming from one pathologist to another. If there is no pathologist present on site to read the slides, there are systems such as robotic microscopy, where the pathologist can remotely take control of the functions on a microscope, such as navigation and focus. And there is also Whole Slide Imaging, which is the entire digitization of a slide to be remotely reviewed. Thanks to advancements in technology, hybrid devices are now available from many vendors with robotics and Whole Slide Imaging functions in one scanner.

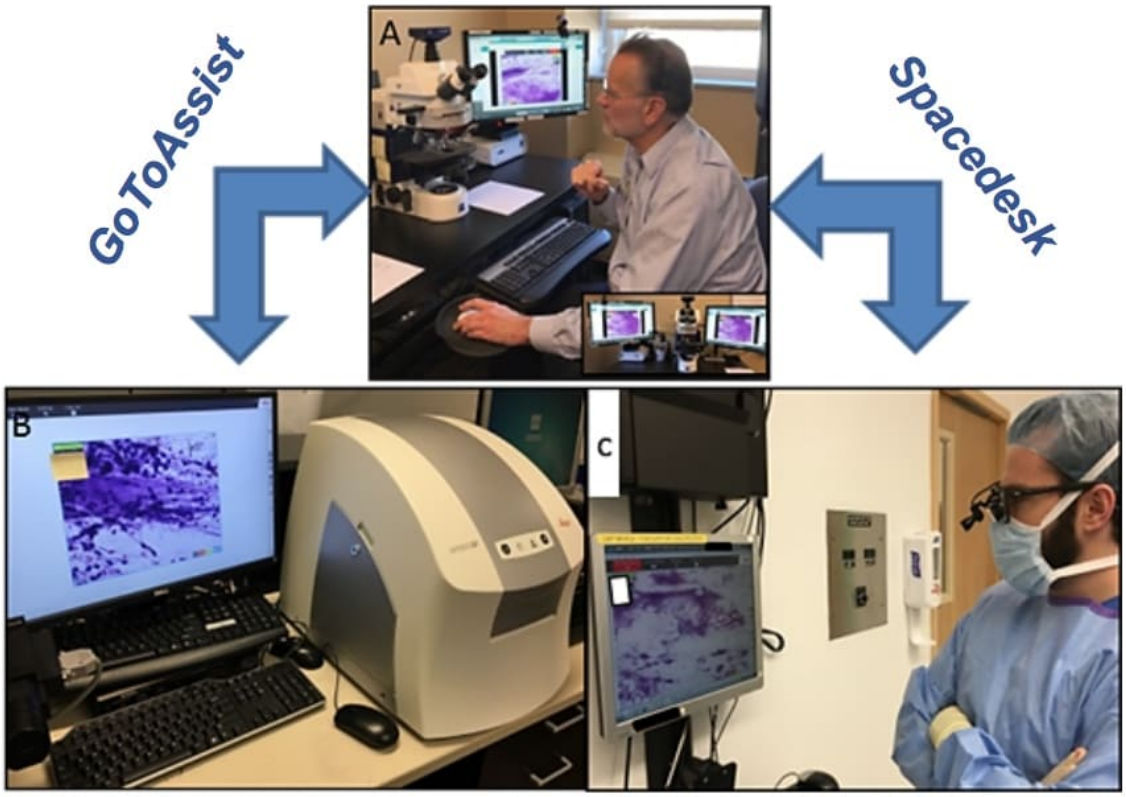

Image courtesy of Dr. Jennifer Picarsic

One of the most common complaints about telepathology is the loss of personal connection between surgeon and pathologist. However, with modern desktop-sharing software, like GoToAssist,

Spacedesk, and others, surgeons can be looped into the frozen section so that they can see what is going on with their cases, which is important for them to remain engaged and to assist with decision-making.

Prof. Pantanowitz then talked about another use for telepathology: **telecytology in the acute care setting**. Rapid On-Site Evaluation (ROSE) has become very popular due to the fact that one proceduralist can now perform minimally invasive diagnostic procedures such as core-needle biopsies. An on-site cytology team then performs an adequacy evaluation, which limits the need for repeat biopsies. Clinical trials for remote cytology showed it to be a more efficient model than on-site, with a diagnostic accuracy comparable to traditional methods. The **advantages** of adopting telecytology for ROSE include the ability to remotely offer ROSE, and thereby maximise small biopsies by reducing non-diagnostic specimens. There is less travel time for pathologists to go on-site, less overall procedural time, and cost saving, as less pathologists are needed for ROSE. Single pathologists can simultaneously perform ROSE at many different locations, and there is more independence for cytotechnologists. Unfortunately, there are also some **disadvantages** in using telecytology for ROSE: less face-to-face interaction with the proceduralists; reliance on personnel on site to navigate the slides and display relevant material; there are an up-front capital investment and ongoing maintenance costs, an initial learning curve, interpretation errors and technology failures. There can also be psychological barriers for pathologists such as technophobia, fear of making mistakes, loss of control and frustration.

The next use for telepathology is for **second-opinion teleconsultation**. Why would one want to share an image? There is a persistent shortage of pathologists around the world, and this is in the face of an increased demand for expert diagnostic consultation. Clinicians also find it useful to share cases and expand their knowledge, and patients themselves recognise the utility of a second opinion.

Although there are clear benefits in migrating to newer instruments and updating software in order to take advantage of more seamless, user-friendly features and more accurate, faster systems, teleconsultation can also be carried out with basic, affordable equipment, such as mobile devices. In fact, the success of remote consultation around the world is very much dependent on implementing low-cost and simple technology solutions. Telepathology can be practiced very simply, using a mobile phone. Mobile networks are actually more reliable than land networks or wi-fi and are accessible almost anywhere in the world. For instance, during conflict in Syria, one area that was majorly deficient was access to pathology care. Prof. Pantanowitz's team set up a hut and trained a person to do simple microbiology testing. Pictures taken with a simple camera were then uploaded to different infectious disease physicians around the world, and all of a sudden there was a world-class microbiology lab in the middle of Syria.

The most important factor for innovation is the desire for innovation, when all the stakeholders collaborate towards technological progress. One such hotbed for innovation is Israel. **Ilan Misano** is a biomedical engineer with a second degree in Economics and Management, who works as a technology transfer consultant between Israel and Italy. In his presentation, he talked about the Israeli telemedicine model and showed examples of Israeli inventions in the field of MedTech. In terms of telediagnosis and monitoring useful for cancer care there are some interesting devices for remote testing. For instance, the Sheba Medical Center, one of the most innovative hospitals in the world, developed a **no-needle blood test**, which is being tested by astronauts in space. The device looks like a pair of binoculars or a microscope that the patient brings to his/her eyes. Inside the eye there are some blood vessels that are transparent. Via the reflection of the wavelength sent into the

eye, we can evaluate some of the components that are in the blood of the patient performing the check. So far, this check is only for blood count, but the lab in Sheba is developing the product further, to include more blood tests.

Another important check is the urine test, and we all know how burdensome it can be. You have to urinate in a cup, arrive to a lab, leave the sample, wait for the results, communicate the results to the doctors. **Healthy.io**, an Israeli start-up, invented a simple kit to do a fully remote urine test. The kit contains a disposable cup and a white strip with 10 different squares that are reagent to 10 different parameters. The patient urinates in the cup and inserts the white strip in the cup. The squares change colour based on the amount of that chemical parameter contained in the urine. Then the strip is positioned next to a reference colour board. The patient downloads an app, takes a picture of the colour board with the strip on it. The AI algorithm in the app is able to evaluate the changes in colour in the strip that was inserted in the urine, and to return semi-quantitative results of the urine test. We know how much these parameters are important, for example, for a screening of bladder cancer where the haematuria is very important, so, evaluating how much blood is inside the urine is crucial. The kit is CE certified; the accuracy is lab standard.

Ultrasound sometimes is important to detect the presence of cancer. **Pulsenmore** is another interesting innovation developed by an Israeli start-up. It allows to do an echography from remote. Currently it is focussed on pregnancy, but hopefully, in the future, the system will also be able to detect for example, a cancer. It consists in a device in which to insert a mobile phone, and an application to download. The system is connected to a telemedicine platform that allows the doctor to see the images from remote, and the app shows the user how to move the device.

Binah.ai is a software solution to monitor different parameters from remote without the need of any device besides a smartphone camera. The system isolates a zone in the face below the eye and is able to evaluate minimal movements of the skin and minute changes in its colour, and from that it can calculate the heart rate and oxygen saturation within two minutes. After two minutes, we can also obtain the respiration rhythm, HRV and stress level. Now the company has also announced the feature of blood pressure evaluation, and they are planning to develop more and more parameters.

So, why is Israel experiencing such a flourish of start-ups and innovation? There are many contributing factors. First and foremost, mentality. People in Israel want to innovate. Due to the harshness of the territory and the environment, the development and use of technology is a must. In Israel there are a lot of start-ups, but also of incubators and accelerators, R&D e-innovation centres, venture capitals, entrepreneurs, private investors, etc. More and more multinational companies are opening offices there to see all the innovation that happens, and also to further develop their own products. For example, in the healthcare and medical field, some of the biggest firms have offices in Israel. There is synergy between different actors in the industry and a lot of money is invested in start-ups. The health system also encourages innovation. There are four insurance companies, which offer a basic free package for Israelis and additional services at a premium. So, they are always competing for customers by offering better services. They all have very structured digital databases, which allow to train AIs to support doctors in their decision making.

Once dealt with the set-up investment and learning curve, telediagnosis can be a valuable addition to healthcare efficiency, with reduced costs and travel time, easier access to specialists and team consultations. The digitalisation of data encouraged by telehealth will improve AI algorithms, making them increasingly more reliable as an aid to diagnosis; and remote, at-home testing devices will contribute further towards a patient-centred healthcare.