The concept of telepathology was introduced in 1986 by the American pathologist Ronald S Weinstein and it has gained increasing attention ever since. However, it is only in the last decade that it has gained considerable ground, thanks to technological developments in parallel with the increased interest from pathologists around the world. Although the use of digital pathology for primary diagnosis is still limited in most laboratories, the technology has already proven highly beneficial in sparsely populated regions. A well-known example is the work from Eastern Quebec, Canada. More recently, studies have shown that digital pathology can be of great help when it comes to quantitative assessments of tissue samples for greater standardisation and more objective and reliable interpretations of various immunohistochemical analyses, including the proliferation marker Ki-67. With the advancement of digital technology, the skepticism towards digitisation has also declined greatly, not least in view of the numerous validation studies that have good results and good agreement comparing diagnosis made digitally on screen versus conventional microscopic methods. The need for good and safe validation has led to the publication of validation guides for laboratories that are willing to take the digital step, a sign that digital pathology is considered being of true importance. The continued progress and evaluation of digital pathology has further shown how it could bring great achievements for education, research and archiving.

Remote work
In our laboratory at Gävle Hospital, the possibilities that digitisation opens up are very tempting. As for many other middle-sized, regional hospitals in Sweden, it is difficult for us to recruit pathologists, especially with the overall pathologist shortage that exists in the country. A major advantage that the new technology brings, in addition to all of the benefits of digital imaging, is the option for pathologists to work remotely. It would be particularly useful for small and remote laboratories to recruit a pathologist independent of where he or she currently resides, and who works for the hospital without having to be
physically present. The working situation thus becomes much more flexible for the diagnostician, both in terms of working place and working hours. Switching from the microscope to the digital screen is not that difficult, and recent studies show that little training is required for pathologists to diagnose digitally at an acceptable level. In our daily work at the laboratory, we have seen that interested pathologists were able to quickly assimilate the knowledge required for working with digital images. Today, one of our pathologists works part-time from home, diagnosing digitally. In addition to the benefit of remote work for the pathologist in question, the digitisation has also made our delivery of glass slides to her much easier and quicker, which, in turn, has led to shortened turnaround time for some of the cases. Moreover, consultations have been greatly enhanced as the pathologists working in the laboratory have been able to view digital images simultaneously with her via direct link, for a fast and safe statement. For us, this has resulted in a more convenient workflow as a whole.

**Digitisation at Gävle**

The digitisation process in Gävle began in earnest in 2012 with the purchase of scanners and software needed for the workstation. Since May 2013, we have scanned glass slides in increasing amounts and today we scan almost all of our produced material. At the moment, our focus lies especially on how to organise and integrate the procedure of scanning acute samples. Right from the start, we have been working to improve both the quality of the scanned images and the efficiency of the scanning procedure so as to avoid unnecessary time loss. In order to achieve this we have, for example, trained special medical laboratory scientists who are responsible for scanning and the quality assurance of the scanned result. Additionally, we have a working group consisting of a group leader, pathologists, IT consultants and others who collaborate and discuss the digital work regularly.

A number of our pathologists use the digital image for primary diagnosis with increasing frequency. Others, not yet primarily diagnosing on the digital screen, are instead utilising the morphometric functions that the technology offers. To build the routine that digitisation of pathology requires in daily work takes time, and the sort of positive attitude that our pathologists in Gävle display is of course essential for the forthcoming development.

At our lab, we also stain with fluorescence for some skin preparations. These stainings are delicate and quickly fade, which is why a pathologist must be present physically to assess the sample. Even these types of samples will benefit from digital technology because the scanned digital image is not affected by fading colouration. Also, with the image scanned, the diagnosing pathologist does not need to be physically present in the lab but can receive the scanned image seconds after the procedure. A further advantage for the pathologist working remotely is operating multidisciplinary rounds digitally, although not yet a reality at our hospital. When it comes to multidisciplinary rounds, it has been seen in Linköping, Sweden, that the efficiency of the rounds increase when the screening is made digitally instead of conventionally with a microscope. This, in turn, leads to additional patients being reviewed every given session and an earlier initiation of treatment.

We believe that the sort of telework described above is promising in the sense that more pathologists will choose to work for smaller sized laboratories, such as ours. For the individual pathologist, this offers the possibility to work for multiple laboratories at the same time, where and when needed.

**A digital pathology network**

The implementation of a digital pathology network is the next step in the digitisation process at Gävle hospital, as well as for certain other laboratories around Sweden. Although the technology yields a good outcome at the local level, it is in collaboration with other hospitals that the full potential is realised. With a number of labs in Sweden implementing digital pathology, such a collaboration will soon be possible. A network interaction would be useful in many ways. Today, glass slides are sent between laboratories by mail. This leads to extended response times and high delivery costs and, above all, the risk of glass slides being damaged or lost. Sending a digital version of the glass slide would eliminate these inconveniences and risks for both sender and receiver. However a prerequisite for establishing a network is optimisation of the digital workflow within every laboratory. A Dutch team has shown what aspects to bear in mind when facing a transition to digital, and the importance of doing it right from the beginning.

As mentioned earlier, the work and development of telepathology in Eastern Quebec has shown very good results. With a primary focus on diagnosis of frozen sections, it was noticed that pathologists working in remote and isolated places were well disposed to the fact that contact and consultation with colleagues in other parts of the region was quick and easy. In parallel, the surgeons working in the smaller remote hospitals were more likely to remain there, knowing they could perform more complete surgery thanks to the increased availability of pathologists. Similar demographics to Eastern Quebec can be found in the northland of Sweden, although on a smaller scale. The promising effects described above are worth pursuing given the current distribution of both pathologists and surgeons in Sweden. One obvious impact would be faster and more accessible health care for patients in the sparsely populated parts of the country.

Digital pathology also offers the prospect of sharing interesting cases for
educational purposes. In Gävle, we have begun extracting such cases and adding them to a database. A national network, and by extension perhaps an international network, would simplify the exchange of knowledge, making it an invaluable source for new resident pathologists, among others. As another example, it would be easy to organise digital-based pathology courses for participants from all around the world, who may not have the time or the finances to travel long distances to assimilate the knowledge they need for their further development. This would indeed be of exceptional benefit for both residents in training, as well as for experienced professionals who need to keep up to date within their own field of sub-specialty.

Expert consultation for improved patient care

While the overall lack of pathologists in Sweden is apparent, the lack of pathologists specialised in certain areas can, at times, be of concern for some laboratories. The expertise within some of the more narrow areas of pathology is getting increasingly centralised in a few laboratories in Sweden, particularly at university hospitals. At Gävle hospital, this often leads to prolonged response time for cases in need of expert consultation, which in turn results in delayed care for patients who might be in need of treatment earlier than others. With digital technology, a fast and secure access to expert review would be a highly prioritised option that could lessen the anxiety for the patient, regardless of final diagnosis. If the diagnosis implicates treatment, quick expert consultation would not only lead to an accelerated treatment but also a more accurate one. The need for a second opinion to confirm the typing and staging of certain cancer diagnoses can be as high as 10–20% of all cancer cases. 12 For unusual types of cancer, a rapid access to expertise is of great importance.

Naturally, the contact with sub-specialised pathologists does not have to be confined within national borders. An international collaboration provided through digital technology would result in a closer cooperation between pathologists, expert consultants and their patients. Also, a fully digitised laboratory is not required. Today, there are mobile phone applications that enable digital pathology images to be shared and viewed from facilities that cannot afford the costly equipment required for digitisation of the workflow. 13 With mobile apps like these, there are already ways to interconnect regions where the digital evolution of pathology would probably take additional time.

Conclusions

The ongoing technological improvements in digital pathology have all the makings of a flexible, more standardised and interconnected way of working, both for the individual pathologist and for pathology at large. The digitisation has also made way for an easier approach to study experienced pathologists’ ways of looking at slides schematically. 14 This information would be useful when teaching new trainees or programming computers in algorithms for automated image processing. Looking further ahead, there are proposals for increased automation by means of digital technology as a step towards streamlining. 15 One of the ideas is that computer algorithms should be able to manage parts of the daily routine work so that the pathologist’s skills are at disposal for demanding cases.

During our work in Gävle, we have seen the limitations of technology today, but also the great possibilities for the future. We dare say that the digital expansion is the next big thing in pathology for Gävle and Sweden, as well as for the rest of the world.

References