PATHXL LTD

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EDUCATION PAPER

PATHXL SIMULATOR: AN ON-LINE DIAGNOSTIC TRAINING AND SIMULATION PACKAGE DESIGNED

Educators and pathology professionals have realized the gap between the safe enclosed learning space of the classroom and the diversity of life experiences that exist in the reporting room. There is a desire to extend the fundamental limitations of one-on-one microscope training. It is into this arena that diagnostic simulation is making an impact. The role of the simulator in this modality is to mimic the real world diagnostic environment so that the trainee can explore it, interact and understand it before the techniques can be applied in the real world. Here the true advantage of simulation is highlighted in that this immersive learning experience can enhance skills, processes and knowledge in a manner reality cannot. PathXL have developed a product which uses many modalities from the world of artificial intelligence and incorporates these with the simulation methodologies to produce an innovative tool for pathology education.

The PathXL Simulator® system is founded in the use of diagnostic decision support systems (DDSS) in pathology (Fig. 1). A DDSS is defined as a methodology for guiding a pathologist through complex decision making processes. DDSSs result in a systematic, ordered, and exhaustive evaluation of evidence as they are combined to form the basis for a final decision. Most DDSSs provide a numeric measure of confidence in the final decision or diagnostic recommendation. Many modalities have been considered in research for implementing DDSS but the modality that best mimics the diagnostic process is that of Bayesian Belief Networks (BBN). In this method uncertainty is assessed in a probabilistic manner by combining evidence to produce a diagnostic probability for the outcome.

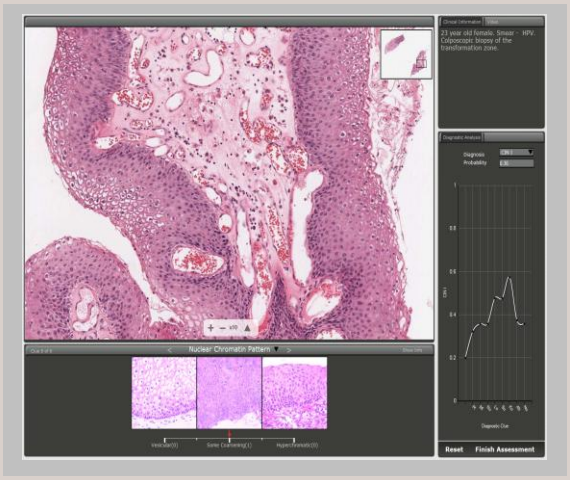

FIG. 1

BAYESIAN BELIEF NETWORKS (BBN)

BBNs have been established by PathXL covering a range of diagnostic scenarios covering 12 tissue types and both modalities of histopathology and cytopathology. In keeping a degree of simplicity a shallow network was used with an open-tree topology, with first-level descendant nodes (evidence nodes) feeding the diagnostic clue (diagnostic node), each independently linked by a conditional probability matrix to a diagnostic node containing the diagnostic alternatives[1] (Fig. 2). All numeric evidence was established by a consultant pathologist for appropriateness. All evidence nodes for any diagnostic scenario ranks the nodes in order of importance as defined by the pathologist and are the exhaustive set of clues[2]. All clues have been assigned a grading pattern that is appropriate to the scenario (i.e. mild/moderate/severe) and are in keeping with common diagnostic practice. A software package PathXL Simulator® has been developed by PathXL to implement all these modalities in a training package.

Virtual Slide: An PathXL Simulator® module is supplied with 20 cases carefully chosen by a pathologist as highlighting exemplar cases (Fig. 3). These show the morphological characteristics that are associated with each condition and a spectrum of cases cover all the major diagnostic outcomes for the diagnostic scenario. Virtual microscopy has facilitated this, where no cases have to be supplied physically on glass. All slides are hosted via the PathXL servers for remote viewing. All cases have been scanned at x40 to ensure optimum diagnostic clarity. The virtual slide can be seen in Fig. 1 and is always present on the PathXL Simulator® interface and is freely navigable.

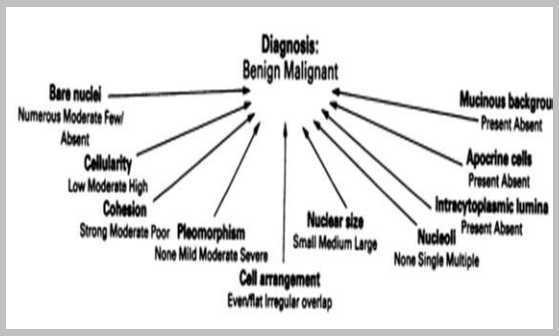

FIG. 2

The Diagnostic Route: In many training packages the end results is simply the correct answer (diagnosis). Within PathXL Simulator® the correct diagnosis is only half of the answer. It is important that trainees get the correct diagnosis and additionally get it for the correct reasons[3]. The graph shown in Fig. 4 is the diagnostic route and tracks the trainee's diagnosis incrementally as each diagnostic clue is assessed. A follow on from this is that each diagnosis if assessed correctly will have a correct final outcome and importantly an associated characteristic graph which defines the diagnosis. Only 1 graph will be correct for that case.

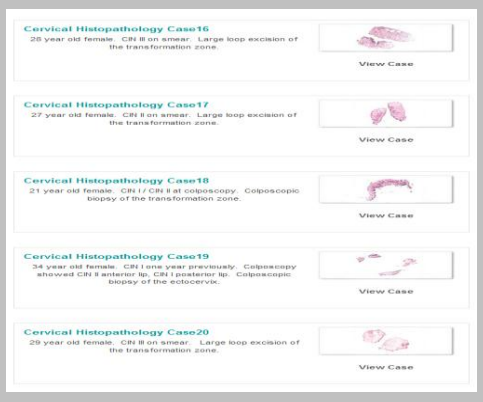

FIG. 3

Evidence Entry: It is important that a trainee be allowed to enter evidence in an intuitive manner that is in keeping with the experience of the user. Consequently PathXL Simulator® has no numeric evidence entry. Numeric interpretation is achieved internal to the software and is based on many theories from the artificial intelligence and fuzzy logic communities. As humans we are excellent at comparing things and not so good at describing things in absolute terms. For this reason the concept within PathXL Simulator® is to show the trainee exemplar images of the diagnostic clue in all its degrees of severity and to allow the user to position a line on the images where they believe the current case lies, shown in Figs. 1 & 5. In this way we achieve a more appropriate interpretation of that clue. Additionally we also have a record of the clue interpretation which goes to form a position on the diagnostic route.

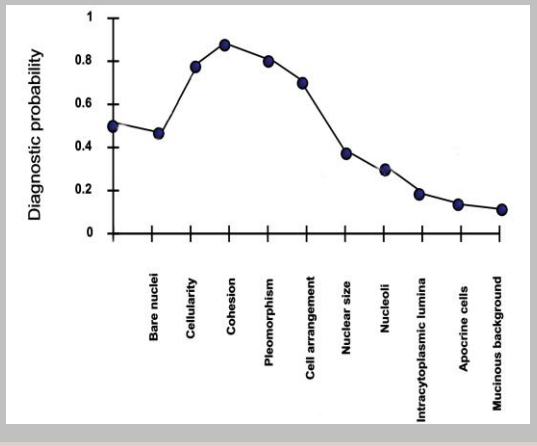

FIG. 4

Training: The diagnostics route graph is used as the basis for implementing the training system. As this represents a user's thought processes in making the diagnosis. It follows if a consultant was to carry out the same process the same would be true. However in this case the graph would represent the route to the correct diagnosis. If these routes are compared it will give a measure of how close to the correct diagnosis the user was. This is highlighted in Fig. 6

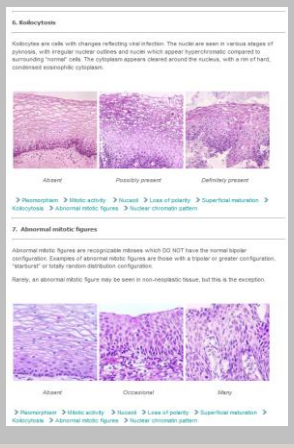

FIG. 5

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Results

In trials with two pathologists of different experience and a series of ten cases, the system provided an effective tool in conveying diagnostic evidence and protocols to trainees. This is evident from the fact that each pathologist only misinterpreted one case and a total of 86%/88% (experienced/inexperienced) of all clues assessed were interpreted correctly. Significantly, in all cases that produced the correct final diagnostic probability, the route taken to that solution was consistent with the expert's solution. A separate paper highlights the results on how PathXL Simulator® is used in an NHS training regime.

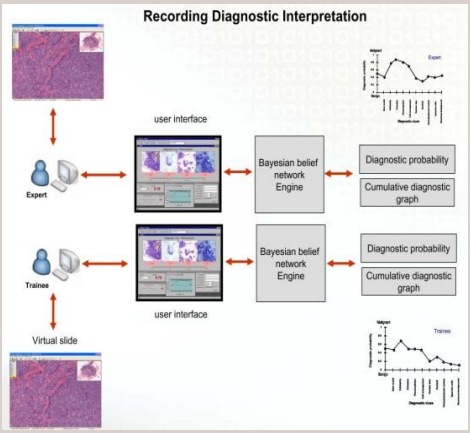

FIG. 6

Conclusions

Using a web browser from home or hospital PathXL Simulator® trainees can now work through real cases and compare their performance to that of an experienced pathologist. The “learning by simulation” approach has been approved by the Royal College of Pathologists London and the Royal College of Pathologists Australasia. Each online module includes a instructional video outlining the diagnostic process authored by an expert and is supplemented by a library of cases with their morphological features.

Research has shown that trainees find PathXL Simulator® useful and informative in exploring the diagnostic scenario. It helps them to bridge the gap between learning from the text books and double headed reporting of real cases with consultants. There are many ways that trainees learn pathology. All are important and a varied approach is needed for optimal learning. PathXL Simulator® provides a useful additional learning resource which complements the traditional methods of teaching.

References

1. The performance of Bayesian belief network for diagnosis and grading prostatic intraepithelial neoplasia (PIN). R Montironi, PH Bartels, D Thompson, M. Scarpelli, PW Hamilton.
2. Computerised Diagnostic Decision Support System for breast fine needle aspiration cytology. J Diamond, NH Anderson, D Thompson, PH Bartels, PW Hamilton
3. Computerised Diagnostic Decision Support System for the Classification of Pre-Invasive Cervical Squamous Lesions. GJ Price, WG McCluggage, ML Morrison, G McClean, L Venkatraman, J Diamond, R Montironi, PH Bartels, D Thompson, PW Hamilton.