Modelling human perception in clinical diagnosis

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In modern clinical setting the flow of information generated by a given patient as they move through the medical system can be quite complex. There are various locations where information is generated (radiology department, emergency rooms, etc.) multiple users (technicians, clinicians, etc.) and various modalities (X-ray, MRI, etc.) which can be complimentary and/or overlap.

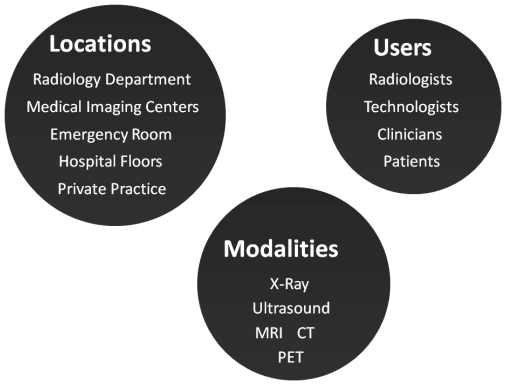

Figure 1: Modelling information flow between different stakeholders.

This macroscopic view can also be looked at from the perspective of a single clinician working at a diagnostic workstation and utilizing the various option at his/her disposal to maximize their throughput without compromising the quality of the patient management.

One of the challenges in a modern clinical setting is to model the flow of this information between the various stakeholders which use different subsets of partially overlapping and complimentary data with the goal of merging these disparate perspectives into a single diagnostic viewpoint. How does one actually begin the modelling process? Clearly dealing with either the individual clinician at a workstation or the medical system as a whole, there are cost involved with each process and decisions that need to be made dynamically depending on the current state of perceived knowledge of the condition of a given patient.

If a model could be built then there are a number of different metrics that would be required. Consider for the sake of argument a single clinician interacting with a machine to arrive at a diagnosis. There may be a certain minimal amount of interaction that is

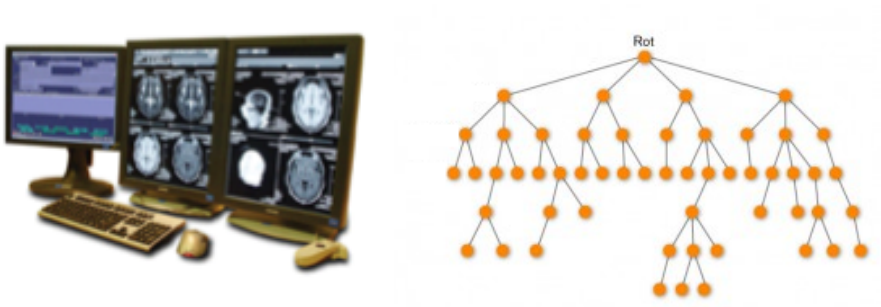

Figure 2: a) Typical diagnostic workstation. b) A perception decision tree.

required to ensure the quality of the partial diagnosis while a plethora of clicking within various software packages may be indicating a level of confusion or lack of competence. If there are a number of different clinicians combining their partial diagnoses, can this be done in a way that increases the throughput of the overall diagnosis without compromising on the quality control? Are there metrics that can be developed to quantify efficiencies for hospital managers? What can be modelled and what cannot be modelled?

There has been some recent work [2] towards the systematic development of applicable models of clinical decision support that are easy to interpret in an attempt to address the modern issues of incompatibility between performance, interpretation and applicability. The goal in this case is to guide clinicians when deciding upon the appropriate treatment, estimating patient-specific risks and to improve communication with patients. Can this material be generalized in an appropriate way? Are the underlying assumptions appropriate for all clinical settings? A review of clinical decision support systems can be found here [1].

References

[1] G. Kong, D.L. Xu, and J.B. Yang, *Clinical decision support systems: a review on knowledge representation and inference under uncertainties*, International Journal of Computational Intelligence Systems **1** (2008), no. 2, 159–167.

[2] V.M.C.A. Van Belle, B. Van Calster, D. Timmerman, T. Bourne, C. Bottomley, L. Valentin, P. Neven, S. Van Huffel, J.A.K. Suykens, and S. Boyd, *A mathematical model for interpretable clinical decision support with applications in gynecology*, PloS one **7** (2012), no. 3, e34312.