

The Design of a Computer Simulator to Emulate Pathology Laboratories: A Model for Optimising Clinical Workflows

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Abstract : This paper outlines the design of a simulator to allow for the optimisation of clinical workflows through a pathology laboratory and to improve the laboratory's efficiency in the processing, testing, and analysis of specimens. Often pathologists have difficulty in pinpointing and anticipating issues in the clinical workflow until tests are running late or in error. It can be difficult to pinpoint the cause and even more difficult to predict any issues which may arise. For example, they often have no indication of how many samples are going to be delivered to the laboratory that day or at a given hour. If we could model scenarios using past information and known variables, it would be possible for pathology laboratories to initiate resource preparations, e.g. the printing of specimen labels or to activate a sufficient number of technicians. This would expedite the clinical workload, clinical processes and improve the overall efficiency of the laboratory. The simulator design visualises the workflow of the laboratory, i.e. the clinical tests being ordered, the specimens arriving, current tests being performed, results being validated and reports being issued. The simulator depicts the movement of specimens through this process, as well as the number of specimens at each stage. This movement is visualised using an animated flow diagram that is updated in real time. A traffic light colour-coding system will be used to indicate the level of flow through each stage (green for normal flow, orange for slow flow, and red for critical flow). This would allow pathologists to clearly see where there are issues and bottlenecks in the process. Graphs would also be used to indicate the status of specimens at each stage of the process. For example, a graph could show the percentage of specimen tests that are on time, potentially late, running late and in error. Clicking on potentially late samples will display more detailed information about those samples, the tests that still need to be performed on them and their urgency level. This would allow any issues to be resolved quickly. In the case of potentially late samples, this could help to ensure that critically needed results are delivered on time. The simulator will be created as a single-page web application. Various web technologies will be used to create the flow diagram showing the workflow of the laboratory. JavaScript will be used to program the logic, animate the movement of samples through each of the stages and to generate the status graphs in real time. This live information will be extracted from an Oracle database. As well as being used in a real laboratory situation, the simulator could also be used for training purposes. 'Bots' would be used to control the flow of specimens through each step of the process. Like existing software agents technology, these bots would be configurable in order to simulate different situations, which may arise in a laboratory such as an emerging epidemic. The bots could then be turned on and off to allow trainees to complete the tasks required at that step of the process, for example validating test results.

Keywords : laboratory-process, optimization, pathology, computer simulation, workflow

Conference Title : ICHIHIM 2016 : International Conference on Health Informatics and Health Information Management

Conference Location : London, United Kingdom

Conference Dates : May 23-24, 2016