

## ABSTRACT

Since the outbreak of the Coronavirus Disease (COVID-19), most, if not all teaching activities has moved to online teaching. At the core the undergraduate pathology education, teachers have to show students plenty of different specimens including both specimen pots and slides and thus particularly affected by the outbreak. E-learning becomes an integral part of education.

Throughout decades of clinical practice, our department have accumulated a large number of excellent specimens useful for teaching students. To facilitate e-learning of pathology, we started a project to produce an indexed library of all available teaching materials on a web-based application with a powerful search system.

The web-app is built on Yii framework in PHP language, supported by MariaDB. Another software, Pathomation, was also acquired facilitate the visualization of the digitized full slide image. The online specimen library allows mobile-friendly rendering of all specialized specimens formats we own, easy searching with immediate suggestions, hierarchical organization of body organs and diseases for classification, laymen friendly uploading and editing workflow and flexibility for future extension.

The online specimen library was opened to CUHK network in May 2019 and it contained all specimens used in the basic pathology course. It can be accessed within CUHK intranet via <https://lib.acp.cuhk.edu.hk/>. Within the web application, there are more than 1000 exhibits covering all major body system.

A cross sectional survey was conducted at the end of the pathology course in 2019 to evaluate students' response and feedback. The system received overwhelmingly positive feedback with 82% of them finding the system useful during tutorial class and 80% of them finding the system useful for preparation and revision. Up to 70 users were recorded during the tutorials and up to 30 users were recorded during non-office hour. Figures suggested this system was widely used among medical students, during and after tutorials.

## OBJECTIVES

1. Produce an indexed library of all available teaching materials including gross specimens, glass slides, photos, documents and scanned slides.
2. Develop a mobile-friendly cross-platform web-based application to facilitate search, retrieval and update of teaching resources.
3. To assist student-directed learning with user-friendly library and to motivate teaching staff to stay updated with the latest classification through consolidating and updating teaching materials

## DESIGN AND IMPLEMENTATION

We have reviewed our current list of specimens and explored other potential specimens. We have found close to 2000 specimens of various kinds including virtual gross specimen, photographs and microscopy slides.

A road map was planned at the beginning of the project after reviewing project management of similar projects. (Fig 1). A prototype system was produced inhouse to facilitate early design, discussion, grant applications and drafting of all the technical specifications. (Fig 2)

The web app was developed by an overseas programming house and was setup within our department. The web app made use of modern technology including Yii2 framework, PHP, MYSQL, HTML5, AJAX etc. to deliver mobile friendly experience across different platforms. This web app also allowed detail classification and indexing of the specimens. A hierarchical structure was used to store diseases and body part classifier, allowing umbrella terms to be used in searching. It has proven to be a lot more user friendly than traditional keyword matching.

To facilitate the visualization of the digitized full slide image, we have set up another new server for a dedicated software from a Belgium company. The new infrastructure allowed demonstration of virtual slides at excellent performance. Student can see the microscopic sections online anywhere, breaking free from the usual limitation of glass slides.

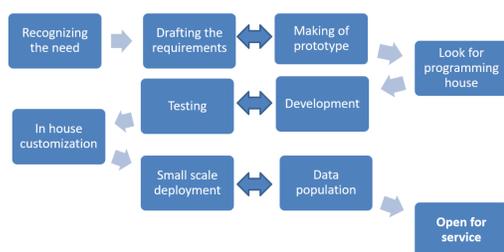


Fig 1. Project roadmap

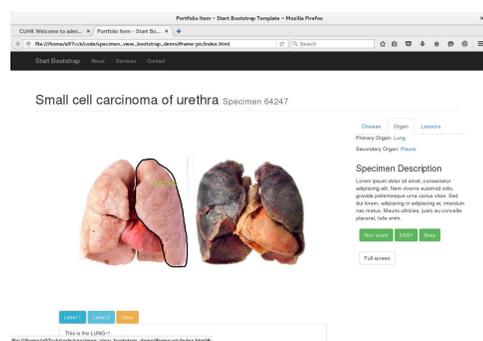


Fig 2. Screenshot of prototype

## SYSTEM FEATURES

The online library was designed to support robust classification of diseases and body organ, while offering an easy and intuitive user experience.

Major features of the (backend) database included:

1. Support for multiple types of specimens, including pictures and diagrams, virtual gross specimens, whole slides images and documents.
2. Multiple detail attributes for each specimen entry. (Fig 3)
3. Hierarchical organization of body parts and diseases to facilitate search with synonyms support. (Fig 4)

Major features of the (frontend) user interface:

1. User friendly and mobile friendly websites (Fig 5)
2. Showing annotations for static images upon user interaction. (Fig 6)
3. Availability of self test mode to assist self learning.

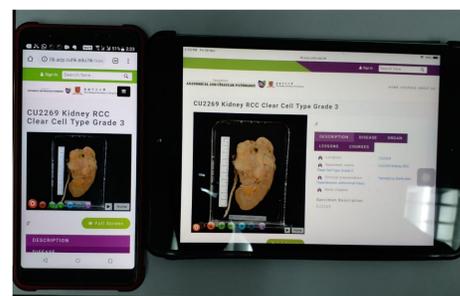


Fig 5. Testing the website for mobile support

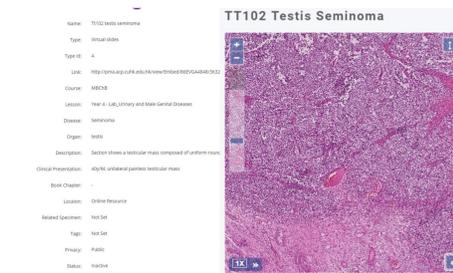


Fig 3. Attributes of a sample specimen

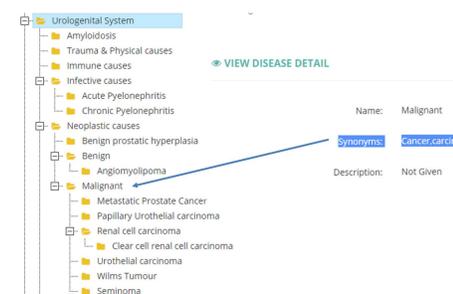


Fig 4. Hierarchical organization of body parts and diseases



Fig 6. Specimen photograph with and without annotations

## DEPLOYMENT

Students helpers, with the help of qualified pathologists, described the selected specimens and made short presentations on the specimens. 12 student helpers were recruited, and more than 100 presentations were made by them in multiple tutorial sessions.

The online library system were opened to CUHK network in May 2019, since the beginning of Basic Pathology Course 2019. It contained all specimens used in the basic pathology course. It can be accessed via <https://lib.acp.cuhk.edu.hk/>.

## EVALUATIONS

A cross sectional survey was conducted at the end of the basic pathology course to evaluate students' response and feedback. Out of 222 returned questionnaires, 160 of them were valid for analysis. 94% of the responded students have heard of the system. Among them, system received overwhelmingly positive feedback with 82% of them finding the system useful during tutorial class and 80% of them finding the system useful for preparation and revision. 83 % of them found the system easy and convenient to use. 208 users reached the online specimen library website as recorded by Google Analytics. Up to 70 users were recorded during the tutorials and up to 30 users were recorded during non-office hour. Figures suggested this system was widely used among medical students, during and after tutorials.

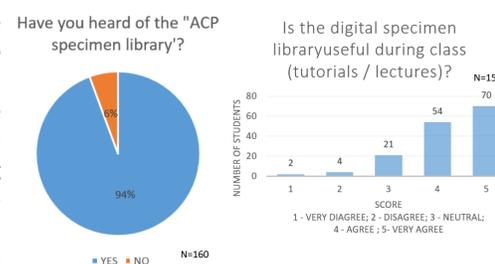


Fig 7. Selected evaluations results (left) 94% of the responded students have heard of the system (right) 82% of them finding the system useful during tutorial class

## ACKNOWLEDGEMENT

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