Convergence for Life Sciences

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Introduction
Life science is a multidisciplinary industry that is facing increasing pressure from convergence. Clinicians and scientists are coming together, given the drive to translate research discoveries into useful clinical applications. One objective is to tackle the recurrent infectious diseases via collaboration across the region. Another goal is to address issues that are becoming important due to the rapidly aging populations across Asia, including the development of preventive medicine to reduce the incidence and associated healthcare cost of chronic diseases, and the need for personalized medicine so that drugs can be tailored for the Asian population.

However, such an exchange between different disciplines and territories results in knowledge gaps. Data formats, ontologies, etc. have to be standardized and mapped so that collaborative research can be effectively executed between experts. More critically, with the rapid advancement in technologies, the trend is to produce data in ever-higher throughput without losing quality. Unfortunately, the current market is divided and characterized by specialized companies that lack cohesiveness and are largely disparate; yet users often choose best-of-the-breed systems (instruments, databases, software) to shorten the research and development cycle, resulting in difficulties when they try to integrate the systems.

These challenges demand the users to be familiar with not only the science, but also informatics. The requirement is for an IT infrastructure that is capable of scaling as the verticals are merged, thus controlling the cost and expertise required. This article describes iBio (intelligent Bioservices system), a suite of components being built as the IT platform necessary for the exchange of information and services across verticals and geographical boundaries. Various iBio components are illustrated as the bridges toward a holistic integration between bioresearch and medical research, ultimately achieving the goal of improving the standard of healthcare.

Filling the Gaps
iBio is delivered to enable collaborative research and development purpose, so that bioservices can be shared efficiently and be offered in a cost-effective manner. This is to jumpstart new life science initiatives and facilitate collaborative development.

Leveraging on J2EE technologies, iBio is delivered as robust web application and database servers to streamline data collection, data management, and data analysis processes. This is implemented across biofacilities so that the services can be simultaneously provided to thousands of users. iBio includes the deployment of software agents to automate the data collection and data preprocessing from specialized instruments. The data are systematically stored in centralized repositories so that users (depending on their read-write accessibility) can electronically share their findings with peers via web services. Through the centralized repositories collected, facility managers can also analyze and optimize the usage of critical resources.
The approach is also to integrate with grid computing providers so as to manage computationally intensive applications (e.g., parallel BLAST, molecular docking systems) and provide a problem-solving platform that would enable not only scientists conducting bioresearch, but also clinicians who wish to delve into biomolecular studies.

At present, iBio has been successfully deployed to manage a zebrafish facility that contains 13,000 tanks of fish for transgenomic research. It has also successfully opened up access to DNA sequencing laboratories for more than 500 users. In Japan, the oligo design processes between three major partners are automated by iBio so that the time-to-market for the oligos is accelerated. iBio’s microarray discovery platform (Fig. 1) is also delivered in Malaysia so as to facilitate research on palm oil and other major cash crops. Standards like the Minimum Information About a Microarray Experiment (MIAME) are incorporated to ease the exchange between users across geographical sites.

Another interesting component of iBio is the clinical research platform (CRP) (Fig. 2). This is a “superwizard” that enables large cohort studies to be conducted and integrated. In a typical disease screening or clinical trial setting, information comes from instruments while nurses/doctors interactively collect patient information on paper. To control the quality, teams have to be set up to check on the processes and data inputs. The CRP hereby relieves the tedious work involved. It is designed to perform systematic data collection and management of such clinical findings over years. The approach is to develop these systems modularly, so that they can be added on as the users’ services grow or as the users expand their scope. The CRP modules include the following:

- Questionnaire module to allow the capturing of data either via PDAs or hardcopy forms;
- Registration, appointment, and subject management modules as administrative functionalities for tracking visits, patients, etc.; and
- Sample tracking module to monitor and analyze urine and tissue samples, etc.
The clinical protocol management module is also of interest. This is an intelligent clinical decision support system that captures knowledge of how clinical protocols are executed by clinicians. The module acts as an “assistant” to monitor clinical outcomes and issue alerts when mistakes are detected during the setting of reappointment dates, qualification of patients, etc. Such evidence-based development reduces errors and enables a more consistent level of care.

When the scope of life sciences extends beyond biomedicine to include agricultural and veterinary medicine, the focus of various Asian countries (including Malaysia, Thailand, China, etc.) is on the surveillance of recurrent threats from bird flu and other zoonotic diseases. One approach is to enable the rapid development of diagnostic kits and vaccines for chicken, tiger prawns, palm oil trees, etc. via platforms (like iBio) that can integrate the manufacturing processes end to end. Good Laboratory Practice and Good Manufacturing Practice that involve compliancy and validation issues hereby become important. It is critical that such processes and systems are validated and are compliant with standards like FDA 21 CFR Part 11, so that the eventual products will find wide acceptance in the market (Fig. 3).

Fig. 2. The clinical pathways that are addressed by the clinical research platform.
What’s Next

Systems like iBio effectively empower patients, clinicians, and scientists to access, manage, and share information. The next step forward is to work closely with users to integrate across the different components of iBio. This will entail the setup of a relevant framework to control the exchange of information so that confidentiality, security, standards, and other important issues are regulated. Ultimately, the objective is to understand the diseases, environment, and population better so that new knowledge can be discovered. This will help to establish the best practices that will be relevant for the development of personalized medicine, disease surveillance, etc.

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