

COMMENTARY

The Intelligent Clinical Laboratory as a Tool to Increase Cancer Care Management Productivity

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Abstract

Studies of the causes of cancer, early detection, prevention or treatment need accurate, comprehensive, and timely cancer data. The clinical laboratory provides important cancer information needed for physicians which influence clinical decisions regarding treatment, diagnosis and patient monitoring. Poor communication between health care providers and clinical laboratory personnel can lead to medical errors and wrong decisions in providing cancer care. Because of the key impact of laboratory information on cancer diagnosis and treatment the quality of the tests, lab reports, and appropriate lab management are very important. A laboratory information management system (LIMS) can have an important role in diagnosis, fast and effective access to cancer data, decrease redundancy and costs, and facilitate the integration and collection of data from different types of instruments and systems. In spite of significant advantages LIMS is limited by factors such as problems in adaption to new instruments that may change existing work processes. Applications of intelligent software simultaneously with existing information systems, in addition to remove these restrictions, have important benefits including adding additional non-laboratory-generated information to the reports, facilitating decision making, and improving quality and productivity of cancer care services. Laboratory systems must have flexibility to change and have the capability to develop and benefit from intelligent devices. Intelligent laboratory information management systems need to benefit from informatics tools and latest technologies like open sources. The aim of this commentary is to survey application, opportunities and necessity of intelligent clinical laboratory as a tool to increase cancer care management productivity.

Keywords: Intelligent - clinical laboratory - cancer care - cancer management - productivity

Asian Pac J Cancer Prev, **15** (6), 2935-2937

Introduction

Cancer as chronic disease is one of the common causes of death in the worldwide. Of the 58 million people who died worldwide in 2005, 7.6 million died of cancer. It is estimated 11.4 million dying from cancer in 2030 (Hackl et al., 2010). Cancer early detection has important role in the decision making process and treatment. Study the causes of cancer, detect cancer earlier, prevent or determine the effectiveness or ineffectiveness of treatment need to access accurate, comprehensive, and timely cancer data (Mohammadzadeh et al., 2013).

Clinical laboratory provide important part of cancer information needs for physicians and influence on clinical decisions, treatment, diagnosis, and patient monitoring. A significant portion of health care costs is devoted to labs (McClatchy, 2002; Kalra, 2004). Poor communication between health care providers and clinical laboratories personnel can lead to medical errors. Medical errors lead to wrong decisions in providing cancer care, inappropriate treatment and or change the patient's treatment plan by

mistake (Bonini et al., 2002; Citak et al., 2013). According to the Pentagon reports, people who die from medical errors each year in the United States are more than the number of Americans killed in the Korean and Vietnam Wars. However, studies show 40% of these errors was preventable. Human errors due to illegible handwriting of doctors, failure in integration of health information systems, lack of timely access to patient records and relevant health information are the most common preventable medical errors in health care (Bria et al., 2009; Singh et al., 2009). Some important medical errors in clinical laboratories that have a significant impact on the performance of this sector, including samples condition, inadequate samples, incorrect samples, sample handling transfer, improper data entry, error in report or analysis, laboratory equipment malfunction, turnaround times (Plebani et al., 1997).

Impact of Laboratory Information

Because of the key impact of laboratory information

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on cancer diagnosis, treatment and delivery of appropriate health services to patients, consider the quality of the tests, lab reports, and appropriate lab management are very important. The aim of this review article is to survey application, opportunities and necessity of intelligent clinical laboratory on the cancer care as a tool to increase cancer care management productivity.

Clinical laboratory as a key factor can increase cancer care management productivity through use of information technology tools.

Information technologies are useful and important tool for the identification and reduction of medical errors, enhance the quality of health care services, improve communication between health care providers (Safdari et al., 2006; Mohammadzadeh, 2011). Hospital information system (HIS) can be identified 89% adverse events and mistakes through physician orders monitoring, check drug interactions, access to relevant information about patient allergies to specific drugs, drug doses control, and so on (Khoubati et al., 2010). In clinical labs samples management, analysis and reporting are time consuming tasks, if done manually are associated with several errors. (Gibbon, 1996) Hence health care centers especially in cancer care field interested in using information technology tools in order to reduce medical errors, decrease costs and increase effectiveness and efficiency. One of the information technology tools that can be used as the subsystem of HIS or apply independently is electronic system in laboratory department.

Laboratory information management system (LIMS) as a significant information technology tools can collect and manage relevant data in clinical labs, provide analysis and store data without the need for traditional archiving. LIMS have an important role in cancer diagnosis, fast and easy access to cancer data, automated quality control, decrease redundancy and costs, save considerable amount of time, high speed data retrieval with low data missed, improve efficiency, integrate many different types of instruments and systems (Tagger, 2011). From 2010 to now these systems more focused on providing a user-friendly and integrated data management solution. (Troshin et al., 2011) Application of laboratory information management systems lead to improve performance in sections such as: planning, resource allocations and budget, samples and orders entry, distribution of samples for analysis, good documentation, provide and deliver of automatic reports, health information flow (Triestram and Partner GmbH, 2013).

Laboratory information management systems in spite of significant advantages are limited by some factors. The main challenge of these systems is problem in adaption to new instruments that may discontinue or change existing work processes in laboratory. Another problem of the laboratory information management systems is adaption to using the new software that is need to different data formats for analysis of new data. Also the greatest limitation of current systems is log, data store and statistical tools that linked in only one direction. In other words clinical lab systems moved from hypothesis to data and then to conclusion. Sometimes users need to analyze the results with various statistical methods

and find new theories. Existing electronic laboratory systems can't use results or hypothesis derived from data analysis directly and automatically (Whelan et al., 2004). Applications of intelligent software simultaneously with existing information systems, in addition to remove these restrictions, have important benefits. Some advantages of the apply intelligent software in cancer clinical laboratory include: autonomy in response and reaction to environment changes, response timely and flexible to dynamic and unexpected changes in environment, act independently in their assigned tasks, learning, negotiation, planning and reasoning capabilities of system (Isern, 2008; Wooldridge, 2009; Bichindaritz et al., 2010). According to E1578 standard guide for Laboratory information management systems under the jurisdiction of American Society for Testing and Materials (ASTM) committee use of artificial intelligence is very useful to customizing LIMS reports, adding ad hoc reporting capabilities such as customization of data exports or database views to external reporting systems or integration to information dashboards and portals. Also intelligent software help to understand the results, combining results from many samples, adding additional non-laboratory-generated information to the reports or certificates of analysis, proper interpretation, and facilitate decision making (American Society for Testing and Materials, 2006). Intelligent clinical laboratories in cancer care management can improve quality and productivity of cancer care services through reducing costs, decrease errors, speed communications, and provide timely, transparent results and reports, appropriate information management, accurate analysis, rapid access to quality information, improve the efficiency and effectiveness with fast-labeled samples, decision support, adoption of necessary changes, meet the user needs. Moreover apply intelligent software in cancer clinical lab is possible when LIMS can able to perform minimum tasks according to international standards for laboratory (Safdari et al., 2012).

Conclusion

In primarily step provide technical and equipment infrastructure, financial and human resources for implementation of electronic laboratories information systems in appropriate level are necessary to benefit from artificial intelligence and implementation of intelligent laboratory management. Implementing electronic systems must be done step by step. Laboratory systems implemented must have flexibility to changes and have the capability to develop and benefit from intelligent devices. Strengthen laboratory information systems indicators in all areas of LIMS system components and evaluation and accreditation of these systems have significantly influence towards achieving intelligent laboratory management. Intelligent laboratory information management systems need to benefit from informatics tools, and latest technologies like open sources. They must have high flexibility, integration with other tools and related systems. Also preparation of back up laboratory data in these systems is especially important. It should be noted that implementation intelligent laboratory systems

require comprehensive view and considering social and human aspects. Important and essential factors must be considered in appropriate planning include motivations, users views, improvement quality of tools and laboratory equipment, adequate education to user, provide suitable tools and equipments, security, and confidentiality.

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