

Clinical decision support systems for improving diagnostic accuracy and achieving precision medicine

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As research laboratories and clinics collaborate to achieve precision medicine, both communities are required to understand mandated electronic health/medical record (EHR/EMR) initiatives that will be fully implemented in all clinics in the United States by 2015. Stakeholders will need to evaluate current record keeping practices and optimize and standardize methodologies to capture nearly all information in digital format. Collaborative efforts from academic and industry sectors are crucial to achieving higher efficacy in patient care while minimizing costs. Currently existing digitized data and information are present in multiple formats and are largely unstructured. In the absence of a universally accepted management system, departments and institutions continue to generate silos of information. As a result, invaluable and newly discovered knowledge is difficult to access. To accelerate biomedical research and reduce healthcare costs, clinical and bioinformatics systems must employ common data elements to create structured annotation forms enabling laboratories and clinics to capture sharable data in real time. Conversion of these datasets to knowable information should be a routine institutionalized process. New scientific knowledge and clinical discoveries can be shared via integrated knowledge environments defined by flexible data models and extensive use of standards, ontologies, vocabularies, and thesauri. In the clinical setting, aggregated knowledge must be displayed in user-friendly formats so that physicians, non-technical laboratory personnel, nurses, data/research coordinators, and end-users can enter data, access information, and understand the output. The effort to connect astronomical numbers of data points, including '-omics'-based molecular data, individual genome sequences, experimental data, patient clinical phenotypes, and follow-up data is a monumental task. Roadblocks to this vision of integration and interoperability include ethical, legal, and logistical concerns. Ensuring data security and protection of patient rights while simultaneously facilitating standardization is paramount to maintaining public support. The capabilities of supercomputing need to be applied strategically. A standardized, methodological implementation must be applied to developed artificial intelligence systems with the ability to integrate data and information into clinically relevant knowledge. Ultimately, the integration of bioinformatics and clinical data in a clinical decision support system promises precision medicine and cost effective and personalized patient care.

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