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Dealing with the Massive Information Flow in Pharmaceutical Research

Pooja Jain

Recent assessments of the pharmaceutical industry have indicated that issues leading to declining performance cannot be solved without major changes to R&D methods, in particular with regard to information management. Drug discovery researchers spend a significant amount of time collating heterogeneous data and wading through mass of cross-disciplinary information, which means it takes longer to gain insight, identify leads and start true development. Solutions exist for pharmaceutical information mining and analysis. These dedicated discovery engines have tailored features that support drug development by functioning in alignment with researchers' needs. This article looks at how such specifically designed solutions can benefit researchers, using as examples two Elsevier Life Science Solutions, PharmaPendium and Reaxys Medicinal Chemistry, which cover every step of the drug development process.

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Introduction

Numerous assessments of the pharmaceutical industry have indicated that it is not performing upto expectations. Some industry insiders have stated that productivity is declining[1,2] and that only significant changes to R&D methodology and the approaches to information could reverse this downward trend.[3,4,5,6] A number of critical issues have been identified, including the massive information flow and the lack of integration of efficient informatics research tools.[5,7,8] Informatics solutions are crucial to the competitive ability of pharmaceutical companies. Dedicated data mining and analysis solutions already exist and offer essential support in dealing with this massive information flow. In 2010, it was estimated that large pharmaceutical company laboratories were producing over 20 terabytes of data per day and this figure has certainly risen since then.[1] A report from Pricewaterhouse Coopers indicated that the data are often unstructured and difficult to search.[9] What this means is that drug discovery researchers spend a significant amount of time collating heterogeneous data and cross-disciplinary information.[1,7] It is difficult to gain insight into the data without the support of dedicated informatics solutions.[5] The longer it takes to do the fundamental data mining and analysis, the slower a laboratory is at identifying leads and starting true drug development.

Access to data sources is not enough in modern research. An interface that allows a researcher to efficiently convert information into knowledge is essential.[5,7,10] Arjun Bedi, a specialist in strategic business transformation initiatives for large pharmaceutical compa-

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nies, refers to this conversion as D2i: data into insights.[5] Beyond that, a good informatics solution should be able to cross the boundaries between fields of science.[1] Drug discovery is an inter-disciplinary process. Multinationals have laboratories spread across the world, not all necessarily applying the same methodologies. A given laboratory may lean more toward any one of the disciplines of biology or chemistry. When multinationals acquire new companies, the integration process does not always homogenize the data output of each acquired facility. Therefore, within and across organizations, there may be issues with ambiguities in terms and terminology.[1] A greater investment in research informatics with D2i capabilities and an understanding of multiple disciplines would help to alleviate these issues.[5] Fortunately, such research informatics solutions do exist with specific database access and interface design for pharmaceutical information mining and analysis. These discovery engines have features that support drug development by functioning in alignment with researchers' needs. The best data management solutions are designed in close communication with experts in the target fields. This development model underlies the creative process for the Elsevier Life Science Solutions Portfolio,[11] which consists of solutions with features created and refined specifically to serve the needs of researchers interested in a given field. These solutions cover various disciplines and are highly focused on data to insight conversion. By recognizing the trends and needs for change in the pharmaceutical industry's approach to information and data management, Elsevier has made its solutions ready for this period of transformation. This can be best illustrated by looking at two specific examples from the portfolio.

PharmaPendium

PharmaPendium is a unique research solution that helps pharmaceutical R&D facilities make more informed assessments of their drug candidates.[12] It focuses on data for preclinical, clinical and post-release safety, pharmacokinetics, and metabolizing enzymes and transporters. These data are sourced from all of the archived Food and Drug Administration (FDA) approval packages from 1938 to the present day, an extensive range of the European Medicine Agency's European Public Assessment Reports, and over 1.3 million pages of drug reviews, including those from the Adverse Event Reporting System (AERS) and Meyer's Side Effects of Drugs. PharmaPendium, covering over 4,000 drugs, provides easy access to regulatory precedents and comparative drug data, supporting decisions about the pipeline and revealing potential biological effects of drug candidates. It allows researchers to search by drug name or drug class, drug target information, and specific adverse effects and toxicity. Multiple input and query options give different possibilities for approaching the data. Safety data are returned quickly and in the context of the organ or organ system affected. The interface also displays comparative data for similar drug candidates. This unique information tool aslo follows the principle of data to insights. Specialized features allow researchers to perform very specific data analysis tasks to achieve more in less time. Query construction and result filtering permits the identification of the effects of single or multiple variables on a drug's performance, so the impact of factors like changes in time and dose can be assessed. Full studies from medical and drug development journals can be accessed. Assessing whether to progress a candidate to clinical trials is easier with the in-depth precedent, pharmokinetics, and metabolizing enzymes and transporters data.

Expanding on the core functionality, PharmaPendium has two dedicated modules. The Pharmacokinetic Module[13] consolidates information on properties such as drug efficacy, indications and dosage, and includes exposure data from FDA approval packages and EMA EPARs. Most of these data have never been published in academic journals. The Metabolizing Enzymes and Transporters Module[14] focuses on drug-enzyme and drug-drug interaction data for risk assessments. Its purpose is to help researchers avoid late-stage drug failures due to unexpected adverse events or changes in bioavailability. One "rate-limiting" step in drug development is the regulatory approval process. The FDA itself indicated the importance of good research informatics resources in the medical research process.[10] With PharmaPendium's extensive FDA and EMA data, drug developers can quickly find information on regulatory precedents to support submissions and assess what issues were encountered with similar candidates during the drug approval process. Database and interface design is also crucial in addressing the issue of non-homogeneous data being produced by laboratories spread across the globe. PharmaPendium makes it easy for researchers with different backgrounds to find and share information. Experts manually extract safety observations and data from the PharmaPendium content and normalize the

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terminology to preventambiguous terminology causing confusion or slowing down research.

Reaxys Medicinal Chemistry

Another Elsevier Life Science Solution with great relevance to the drug discovery process is Reaxys Medicinal Chemistry,[15] which is designed for pharmaceutical researchers whose focus is on identifying lead compounds and drug repurposing opportunities. It helps in selecting the best candidate compounds before moving to preclinical phase, thus mitigating the financial risk of later-stage preclinical and clinical studies on a compound that would likely fail. Reaxys Medicinal Chemistry covers millions of chemical compounds and thousands of proteins that can act as drug targets, aligning them with the results of biological experiments. The interface allows text or graphic input, permitting structural searches. Search results can be filtered using several categories, such as compounds and fragments by name, structure, and structural similarity; quantitative and qualitative compound-target interaction data; molecular targets; and pharmacological effects.

These are just two examples of the Elsevier research informatics solutions that are intended for specific researchers with their tasks and needs in mind. Others include the Reaxys Chemistry Discovery Engine, which is designed to give insight into chemistry, and Pathway Studio, which is a molecular biology research solution. Compatibility between solutions in the Elsevier Life Science Solutions Portfolio works toward overcoming the "discipline barrier" that can exist between researchers approaching the drug development process from different academic backgrounds. The features and functionality of leading research informatics tools, such as PharmaPendium and Reaxys Medicinal Chemistry, developed because companies like Elsevier recognized the shift in the R&D landscape[1,2,3,4,5] and the need for better tools to manage the massive information flow.[7] The pharmaceutical industry urgently needs to embrace innovative research informatics if it is to significantly improve its return on R&D investments.

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