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Technology Transfer in Pharmaceutical Industry; Facts and Steps Involved

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ABSTRACT

Technology transfer plays a vital role in the process of drug discovery to the product development and the full scale commercialization. The article attempts to discuss about the technology transfer process, steps involved in technology transfer, reasons for using technology transfer, importance of technology transfer and the issues involved in the technology transfer in the pharmaceutical industry.

Keywords: Technology transfer, Steps involved, Scale up, Exhibit.

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INTRODUCTION

Technology transfer is the practice of transferring scientific findings from one organization to another for further development, So that new products such as medicines, educational tool, electronic devices, safety equipment and health services can become available to the public. Technology transfer is the intersection between business, science, engineering, law and government.[1, 2]

Technology transfer is both integral and critical to the drug discovery and development process for new medicinal product. This process is important for to elucidate necessary information for technology transfer from R & D (Research &Development) to PDL (process development laboratory) and for development of existing products to the production for commercialization. Technology Transfer is helpful to develop dosage forms in various ways like it provides efficiency in process, helps to maintain quality of product, helps to achieve standardized process, which in turn facilitates timely & cost effective production.[3, 4]

Technology transfer usually involves some source of technology that possess specialized technical skills, which transfers the technology to a target group that do not possess those specialized technical skills, and who therefore cannot create the tool themselves. Technology transfer often involves the licensing of intellectual property rights and extending property rights and technical expertise to developing firms.[20]

In the pharmaceutical industry, "technology transfer" refers to the processes of successful progress from drug discovery to product development, clinical trials and ultimately full-scale commercialization. It is the process by which an original innovator of technology makes its technology available to commercial partner that will exploit the technology.

So, there are 3 standards in the definition of technology:

- First, knowledge must be systematic. This means that it must be organized in terms of providing solutions to problems.
- Second, knowledge must exist in certain places like in someone's head or in documents, and must be able to be presented, so no matter what it means it must be able to be transferred from one person to another.
- Third, it must have purpose-orientation, so that it can be utilized for useful purposes in industry, farming, and commercial fields.[5]

It is a systematic procedure that is followed in order to pass the documented knowledge and experience gained during development and or commercialization to an appropriate, responsible

and authorized party. Technology transfer embodies both the transfer of documentation and the demonstrated ability of the receiving unit (RU) to effectively perform the critical elements of the transferred technology, to the satisfaction of all parties and any applicable regulatory bodies.[6]

Transfer of technology requires a documented, planned approach using trained and knowledgeable personnel working within a quality system, with documentation of data covering all aspects of development, production and quality control. Usually there is a sending unit (SU), a receiving unit (RU) and the unit managing the process, which may or may not be a separate entity.[7]

In recent years, there is a growing awareness that an appropriate transfer of manufacturing technologies (technology transfer) is important to upgrade drug quality as designed during R&D to be a final product during manufacture as well as assure stable quality transferred for many reasons between contract giver and contract acceptor during manufacture. The drug quality, it is desired to make sure 5 W's and 1 H, that is what, when and why information should be transferred to where and by whom and how to transfer, then share knowledge and information of the technology transfer each other between stake holders related to drug manufacturing.[8]

Technology transfer in pharmaceutical industry:

In the pharmaceutical industry technology transfer refers to the processes that are needed for successful progress from drug discovery to product development, to clinical trials to full scale commercialization or it is the process by which a developer of technology makes its technology available to commercial partner that will exploit technology. In pharmaceutical industry preparation of dosage form needs scale up in/at several stages, such as small scale laboratory development from 0.5-2kg batch can be scaled up to 5-10 kg and then to 20-100 kg on a pilot scale. Production scale can typically range from 200 kg to greater than 1000 kg. Technology transfer involves manufacturing drug product with increasing batch sizes on larger equipment or using continuous processing on pilot scale equipment. Generally scale up involves the transfer of technology and the transfer of knowledge that has been accumulated during the small scale development of product and processes. It is important to realize that good communication is critical for formulation and process transfer to be successful. It is essential for a researcher or developer of technology to make available this technology to another person's to exploit for the progress of development of technology and for exploitation of a technology in different fields of applications and to make is use with another organization that may have better manufacturing capability, marketing capability and commercial capability. In the pharmaceutical industry,

technology transfer by collaborating with other departments and other organizations to commercialize a pharmaceutical product is a common process.[9, 10, 11]

TECHNOLOGY TRANSFER IN INDIAN PHARMACEUTICAL INDUSTRY

The pharmaceutical industry is a technology-intensive, science-based industry, with biotechnology playing an ever-increasing role in its development – a feature of the industry that has grown in importance in recent years. [15]

Ballance, Pogany and Forstner (1992) have presented a typology of the world's pharmaceutical industries. They identified 10 countries (all of them developed) as "countries with a sophisticated pharmaceutical industry and a significant research base". The next group of 17 countries was identified as "countries with innovative capabilities". India is one of the countries in this group. While these countries are not active in discovering new molecular entities they have the technological capability to either develop innovative processes or improved formulations of already discovered drugs. [15]

During the 1990s policies relating to transfer of technology have been liberalized in the form of easier procedures, removal of restrictions on royalty or technical fee payments, removal of restrictions on inclusion of restrictive clauses in arrangements, and no scrutiny for repeated imports, among others. However, all these measures have failed to increase the number of collaboration agreements in the Indian pharmaceutical industry. According to Narsalay (2000), there were a total of 187 technical collaboration approvals in the drug industry during 1991-1999, which constituted 3.1 per cent of all the technical collaboration agreements approved during that period. This is a very small figure for such a technology-intensive sector.[15]

Effective Factors in Technology Transfer

In the technology transfer process, the entire elements of the technology triangle (Technical, Organizational and Cultural aspects) are to be transferred into organizations and not impose them solely into technology's hardware parts. Thus, they should be fully cognizant of their capabilities and requirements before launching technology transfer. Actually, technological evaluation, requirements and capacities recognition and selection of technology methods are of vital importance in the technology transfer process. Thus, awareness of effective factors on technology transfer is of great importance for technology recipients.[12, 14, 18]

REASONS FOR TECHNOLOGY TRANSFER[18,19, 15]

There may be many reasons why a developer of the technology might consider making its technology available to another person to exploit, instead of exploiting the technology itself.

Some of these are:

- Forming alliances with partners that can progress the development of the technology to take it to market-

  The developer of the technology might have the resources to take the technology to particular state of development, such as up to animal studies and toxicology studies, but does not have the resources to take the technology through its clinical and regulatory phases, and must collaborate with another organization to take it through these phases, and into the market.

- Forming alliances with partners with manufacturing capability-

  The developer of the technology may have taken the technology to a state of development so that it is near market ready, but does not have the clean room manufacturing capability or resources to manufacture the product, and must partner with another organization that dose have that capability.

- Forming alliances with partners with marketing and distribution capability-

  The developer of the technology may have fully developed the technology and even have obtained regulatory approvals and product registrations for the product to be sold, but it lacks the marketing and distribution channels to give it a marking capability and must collaborate with another organization that doses have that capability.

- Exploitation in a different field of application-

  The developer of the technology might be capable of exploiting the technology itself in the field of diagnostic applications, and may grant exploitation right to commercial partner for the exploitation of therapeutics applications. By transferring the technology for the use in another field of application to another person, the developer of the technology creates another income stream from the exploitation that takes place on that takes place in that other field.

- No Commercial capability-

  The developer of the technology may be research institute of a university, which does not have the capability to exploit commercially at all, and need to collaborate with another organization that does have that capability. In the exploitation of pharmaceutical products, technology transfer by collaborating with this way to bring a pharmaceutical product to market is common feature of the industry.

Importance of Technology Transfer in Pharmaceutical Industry [19]

- To elucidate necessary information to transfer technology from R&D to actual manufacturing by sorting out various information obtained during R&D;
- To elucidate necessary information to transfer technology of existing products between various manufacturing places;
- To exemplify specific procedures and points of concern for the two types of technology transfer in the above to contribute to smooth technology transfer. This is applies to the technology transfer through R&D and production of drug (chemically synthesized drug substances and drug products) and the technology transfer related to post-marketing changes in manufacturing places.

STEPS IN TECHNOLOGY TRANSFER[15, 19]

Technology Transfer is not a single way process. Whether a tablet, a Transdermal patch, a topical ointment, or an inject able, the transformation of a pharmaceutical prototype into a successful product requires the cooperation of many individuals.

The classic view of a flow from basic to applied technology is a great oversimplification-sometimes, e.g. problems or insights arising at the production level give rise to new ideas that contribute to fundamental basic advance. At least in some sectors, close links between the basic researchers and manufacturing experts, and even marketing personnel contribute to competitiveness and advancement.

During development of a formulation, it is important to understand procedure of operations used, critical and non-critical parameters of each operation, production environment, equipment and excipient availability, which should be taken into account during the early phases of development of formulation, so that successful scale up can be carried out. Appropriate care during technology transfer is important to enhance drug quality as developed by R & D in final formulation as well as to assure quality for predetermined period of time. The various steps involved in technology transfer are given below:

Development of Technology by R & D [13, 15, 19]

- Design of procedure and selection of excipients by R & D:

  Selection of materials and design of procedures is developed by R & D on the basis of innovator product characteristics. For this different tests and compatibility studies are done.
- Identification of specification and quality by R & D:

Generally it should be considered by R & D that quality of product should meet the specifications of an innovator product. For this different stability studies are carried out for innovator product and for product which is to be manufactured.

- Technology transfer from R & D to production:

  R & D provides technology transfer dossier (TTD) document to product development laboratory, which contains all information of formulation and drug product as given below:

  - Master formula card (MFC) includes product name along with its strength, generic name, MFC number, page number, effective date, shelf life and market.
  - Master packaging card gives information about packaging type, material used for packaging, stability profile of packaging and shelf life of packaging.
  - Master formula describes formulation order and manufacturing instructions. Formulation order and Manufacturing Instructions gives idea of process order, environment conditions required and manufacturing instructions for dosage form development.
  - Specifications and standard test procedure (STPs) helps to know active ingredients and Excipients profile, in-process parameters and specifications, product release specification and finished product details.

OPTIMIZATION AND PRODUCTION[13]

- Validation studies: Production is implemented after validation studies that can verify that process is able to stabilize the product based on transferred manufacturing formula. While the manufacturing department accepting technology is responsible for validation, the research and development department transferring technology should take responsibility for validation such as performance qualification, cleaning validation, and process validation which are unique to subject drugs.
- Scale up for production: Scale up involves the transfer of technology during the small scale development of the product and processes. It is essential to consider the production environment and system during development of process. Different operations e.g. dispensing, sifting, blending, compaction/dry granulation/wet granulation, compression, coating are used in the formulation of solid dosage form. From blending to film coating, each process is easy for pharmaceutical professionals to be absorbed in the particular part of the manufacturing process for which they are directly responsible. Operators

concentrate on keeping their segment of the production process running smoothly. But the whole manufacturing line can be improved, even before production begins, if technology transfer is implemented thoughtfully. Effective technology transfer helps to provide process efficiency and control and maintain product quality

Technology Transfer Documentation[13]

Technology transfer documentation is generally interpreted as document indicating contents of technology transfer for transferring and transferred parties. Each step from R & D to production should be documented, task assignments and responsibilities should be clarified and acceptance criteria for completion of technology transfer concerning individual technology to be transferred. It is duty of quality assurance department to check and approve the documentation for all processes of technology transfer.

- Development report: The ultimate goal for successful technology transfer is to have documented evidences. The R & D report is a file of technical development, and the research and development department is in charge of its documentation. This report is an important file to indicate rationale for the quality design of drug substances and drug specifications and test methods. The development report before the approval inspection, although the development report is not prerequisite for the application for approval, it can be used at the preapproval an inspection as valid document for quality design of new drug. In addition, this report can be used as raw data in case of post-marketing technology transfer. The development report contains data of pharmaceutical development of new drug substances and drug products at stages from early development phase to final application of approval, information of raw materials and components, rational for dosage form & formula designs and design of manufacturing methods, change in histories of important processes and control parameters, stability profile, specifications and test methods of drug substances, intermediates, drug products, raw materials, and components, which also includes validity of specification range of important tests such as contents impurities and dissolution, rational for selection of test methods, reagents and, columns, and traceability of raw data of those information.
- Technology transfer plan: The technology transfer plan is to describe items and contents of technology to be transferred and detailed procedures of individual transfer and transfer schedule, and to establish judgment criteria for the completion of the transfer. The transferring party should prepare the plan before the implementation of the transfer and reach an agreement on its contents with the transferred party.

- Report: Report completion of technology transfer is to be made once data are taken accordingly to the technology plan and are evaluated to confirm that the predetermined judgment criteria are met. Both transferring and transferred parties can document the technology transfer report; however, they should reach an agreement on its contents.
- Exhibit: After taking scale up batches of the product, manufacturing of exhibit batches take place. In case of exhibit, batch sizes are increased along with equipments and their processes involved. They are done for filing purposes in different regulatory agencies.

CONCLUSION[16,17]

Effective technology transfer is critical to success in pharmaceutical industry. In pharmaceutical industry technology transfer can be defined as the transfer of scientific information, a capability or a technological basis associated with a drug or a pharmaceutical procedure from a donor side (knowledge center) to a receptor side (drug manufacturing plant) implying a positive experience learned and realized by both sides and complying all the regulatory requirements in terms of Efficacy, Quality and Safety.

A healthy communication between different countries and different organizations are the key to the success of Technology transfer and development. So, the knowledge and information should be transferred equally and continuously from transferring party to the transferred party, this will help in the product manufacturing process and thus the development of both the parties.

REFERENCES:

1. Domb E. Using TRIZ to Accelerate Technology Transfer in the Pharmaceutical Industry; PGTJ 2004; 3-5.
2. http://www.research.cornell.edu/cotab
3. Reamer A. Icerman L and Youtie J. Technology Transfer and Commercialization: Their Role in Economic Development, EDA Public documents 2003
4. Patel DS. An overview for pharmaceutical industry. IBAP 2010; 1-10.
5. http://aspx?ContentID=193
6. www.gsk.com/policies
7. Technology 4sme.net/images/pdf%20floder/ttps_ http://www.chapter_3.pdf.
8. ISPE Good practice guide. Technology transfer. Tampa, F.L. International Society for Pharmaceutical Engineering, 2003.
9. Janodia MS, Sreedhar D, Ligade VS, Pise A and Udupa N. Facts of Technology transfer: A perspective of Pharmaceutical industry, J. Intellectual property rights 2008; 28-34.

10. Ruegger CE, Royce AE and Mollan MJ, Wagner RF, Valazza SJ and Mecadon MR. Scale up of Solid Dosage Forms 2006
11. Mendes PC. Licensing and Technology Transfer in the pharmaceuticals Industry Cited 2010.
12. Reamer A. Icerman L and YoutieJ. Technology Transfer and Commercialization:Their Role in Economic Development 2003.
13. Singh A and Aggarwal G. Technology Transfer in Pharmaceutical Industry: A Discussion. IJPBS. 2009; 1-3.
14. Mahboudi Mand Ananthan BR.Effective factors in technology transfer in the Pharmaceutical Industries of Iran: A Case study. The IUP Journal of Knowledge Management 2010; 1-2.
15. Biswajit D and Rao N. Transfer of Technology for Successful Integration into the Global Economy: A Case Study of the Pharmaceutical Industry in India. UNCTAD 2002.
16. Luis Alberto del Río, Nuria Salazar, Carmen Trives, Guidelines for a pharmaceutical technology transfer towards a drug manufacturing plant, Bol. Soc. Quím. Méx. 2007.
17. Del Rio, L.A. Ind. Farm. 2001. 64-68.
18. Bateni M. Selection of Appropriate Technology for Developing Countries, Tadbir. 2000; 108.
19. http://www.amuasi-paper-edited.pdf.
20. www.ncbi.nlm.nih.gov/pubmed/12613797