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BEST PRACTICES IN DRUG SAFETY & RISK MANAGEMENT – INDIAN CONTEXT

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***Abstract*—In this project, best practices in Drug Safety and Risk Management has been defined. Keeping in view the Indian context, comparison scale has been analyzed with few developing countries. These analyses are based on secondary data research. Comparison of policies also been covered under this subject.**

***Index Terms*— Drug Safety, Risk Management, Clinical Trials, Case Report Forms**

I. INTRODUCTION

The term Drug Safety is defined as the science and activities relating to the detection, evaluation, understanding, and prevention of adverse reactions to medicines or any other medicine-related problems. The definition and scope of Drug Safety have evolved to recognize the importance of a systems approach for monitoring and improving the safe use of medicines. Therefore, the assessment of benefit versus risk is mapped during the preclinical evaluation of a medicinal product and is focused to extend throughout its full life cycle.

As a result, there is now added focus on safety and risk assessment after a product has received regulatory approval, when it is placed on the market and prescribed to large populations. Although there is no international standard that dictates the components of an adequate drug safety system or the processes to be engaged in risk management, there is consensus among the major regulators that drug safety and risk management is necessary and important in the development and commercialization of medicinal products

Ongoing drug safety is being understood as an essential to the only appropriate way to develop safe medicines, introduce them into the market, and have them survive in the market once approved. Patients want information about the drugs they are taking, and actively seek this information from various sources, including the Internet. Therefore it is necessary in building capacity for clinical trials to understand the components, the functions, and the processes required for full and effective Drug Safety and Risk Management.

II. DRUG SAFETY AND RISK MANAGEMEMENT IN INDIAN CONTEXT

India is perceived as a developing country, but it is developing at a pace that is not matched by many others. We have experienced significant economic growth. India is the fourth largest producer of pharmaceuticals in the world. It is emerging as an important Clinical trial hub in the world. Many new drugs are being introduced in our country. There is a need for a vibrant drug safety and risk management system in the country to protect the population from the potential harm that may be caused by some of the new drugs. Now a days in India, drug safety and risk management situation has been progressing step by step as what it was in the past.

The regulatory bodies like Drug Controller General of India (DCGI) along with several organizations marching ahead with an objective to make an attempt to implement Drug Safety programs in India along with its training modules. Most of the pharmaceutical companies stab to regulate and implement an effective system of reporting adverse events of drugs introduced in the Indian market with newly beginning of Drug Safety department.

Drug Safety in India is termed as an important and integral part of clinical research. Therefore, both clinical trials safety and post marketing drug safety are critical throughout the product life cycle.

Indian Pharmaceutical and Drug Industry Facts

- India has 2,633 FDA-approved drug products. India has over 546 USFDA-approved company sites, the highest number outside the US
- Cost-efficiency continues to create opportunities for Indian companies in emerging markets & Africa
- Growing per capita sales of pharmaceuticals in India offers ample opportunities for players in this market
- Per capita sales of pharmaceuticals expanded at a CAGR of 17.6 per cent to US$ 33 in 2016
- Economic prosperity would improve affordability for generic drugs in the market & improve per capita sales of pharmaceuticals in India

Sources: BMI and Financial Express

A. Best Practices – Indian Context

- Collaborating between Foundation / NGOs/ Corporate and Ministries to produce a series of briefing papers on the practical implementation of drug safety and risk management assignments in India.

- Promoting the safest use of medicines through contributing to appropriate education and training related activities in the field of drug safety and risk management across the country.

  The Central Drugs Standard Control Organization (CDSCO), Directorate General of Health Services under the aegis of Ministry of Health & Family Welfare, Government of India in collaboration with Indian Pharmacopeia commission, Ghaziabad is initiating a nation-wide Drug Safety and Risk Management programme for protecting the health of the patients by assuring drug safety.

- Monitoring the quality of imported drugs by making mandatory for Registration of Manufacturing site and products before import.

- Enhanced Capacity of drug testing facilities at both state and central drugs testing laboratories under Centrally Sponsored Scheme.

- Strengthening of the regulatory infrastructure by enhancing capacity in existing drug laboratories at the sates and central level through infrastructure and equipment strengthening and training of personnel to upgrade their skill under Capacity Building Project.

- The government introduced mechanisms such as the Drug Price Control Order and the National Pharmaceutical Pricing Authority to deal with the issue of affordability and availability of medicines.

- The Government of India unveiled 'Pharma Vision 2020' aimed at making India a global leader in end-to-end drug manufacture. Approval time for new facilities has been reduced to boost investments.

- The Government of India is planning to set up an electronic platform to regulate online pharmacies under a new policy, in order to stop any misuse due to easy availability.

B. Best Practices in Laws and Policies – International Case Studies

Today's increasing pace of innovation in the Life-Sciences industry is resulting in ever larger number of drugs and medical devices along with risk management practices coming to the market every year. Simultaneously, geographical expansion into newer markets has resulted in exponential business growth. Today, the need for transparency has dramatically changed the picture and drug safety has become a multifaceted field. The World Health Organization (WHO) defines drug safety as the science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other drug related problem

Globally, there is growing awareness that increased deployment of drug control safety measures, which is critical for addressing several health and safety related issues, creating new economic opportunities, and providing health safety access to the billions of people not only to prevent harm by identifying safety problems, but also to promote appropriate use of medicines by providing timely information on safety aspects and promoting a more balanced risk/benefit assessment by the prescriber.

Case Studies of Major Countries are mentioned below:

1. China: Drug safety and risk management have become important public health issues in China. The rapid development of drug safety observation in China is manifested in extensive organizational structure, development of large databases, and laws and regulations supporting drug safety and risk management. The two major laws are the China Drug Administration Law issued in February 2001 and the Regulation for the Administration of ADR Reporting and Monitoring issued in March 2004.

There is no gold standard for a drug safety observation system. Variations in culture and clinical practice across countries make it impossible for China to simply adopt another country's practices without modification. However, what the China's State Food and Drug Administration (SFDA) has been doing and will continue to do is, first, learn from its own unique challenges. Several drug safety events held were unique to China, and it was up to China's relatively new system to handle the crises.

Second, China does have some well-developed systems in other countries that it can try to mimic, to the extent that it makes sense. It can watch the new developments across the globe to find best practices for application. Third, the evolution of thinking about drug safety and risk management is that there should be a multidisciplinary approach to drug safety, making use of expertise in risk management and other relevant disciplines. It also should apply to the entire life of a drug from investigation, through new drug application, marketing, and withdrawal (if necessary) from the market.

2. United States of America (U.S.A): In USA, drug safety and risk management are key activities for ensuring that the right products get to patients at the right time with the right balance of benefits and risks. Optimizing benefit-risk is an important matter not just for regulators, but for all

stakeholders, and planning for drug safety activities and appropriate evidence gathering is done throughout the medicine life cycle. Against a backdrop of rapid therapeutic innovation, technologic advances, and widening choices of potential safety data sources and analytical methodologies, the drug safety and risk management of today demand ever smarter approaches.

Regulatory requirements for development, approval and marketing of medicinal products including drug safety in US are defined with the help of laws, regulations and guidance documents. In United States, "law" is a written statute, requirement or ordinance that has been passed by the legislature and then signed into law by executive. The underlying laws Food and Drugs Cosmetic Act (FD & CA) or Public Health Services Act (PHS Act) provide the general legal authority to Food and Drug Administration (FDA) to require essential activities, including the ones relevant to safety of biological products and drugs. Specific standards are set forth in the regulations and guidance documents.

Food and Drug Administration (FDA) published three guidance documents focusing on various aspects of drug safety and risk management for better upcoming future in pharmaceutical industry of United States.

a. Pre-Marketing Risk Assessment

b. Development and Use of Risk Minimization Action Plan

c. Good Drug Safety practices and Pharmacoepidemiological Assessment

FDA has published likewise several other guidance documents that explains FDA's opinion on various issues related to the safety of medicinal products, for example Data Monitoring Committee, Drug Induced Liver Injury, Labeling Changes etc.

3. Germany: In context of Germany, Drug Safety and Risk Management focuses specifically on the reporting of adverse reactions to biologic medicines, and makes recommendations of how processes can be improved in the country to better protect patients. In Germany, there is a well established drug safety and risk management system, with processes in place for sharing new information with doctors. There is also a good cooperation between the different agencies with responsibility of drug safety and risk management strategies.

Highlighting the challenges in Germany are basically a lack of awareness among patients and doctors regarding adverse event reporting, leading to resulting reports varying in quality, gaps in the current academic education for doctors around drug safety and pressure on the budgets available for drug safety systems.

To mitigate the above challenges in the sector of Drug Safety and Risk Management, patients and public are advised to suggest the following to policymakers to help improve the drug safety and monitoring mechanism systems in Germany:

a. Awareness raising campaigns to improve the understanding of drug safety among patients and health care professionals.

b. Ensuring a wide range of user friendly channels through which patients can report any adverse reactions.

c. Making academic training on the importance of drug safety mandatory for all for healthcare professionals.

d. Ensuring sufficient funding for risk management and monitoring agencies.

Germany was considered as fourth largest pharmaceutical market in the world, with a turnover worth US $42,621 million in 2015.

The current German Drug Safety approach is mostly harmonized within the EU and ICH framework although there are German specific requirements for company personnel and the handling of Decentralized Hospital Computer Program (DHPCs).

4. Japan: There are two particular tragedies that rocked Japan and forced the government to tighten regulation of Drug Safety in the pharmaceutical industry. The first and most important was the use of Hepatitis C infected blood products between 1971 and 1990, which resulted in at least 10,000 patients being infected with Hepatitis C. The second tragedy was the use of HIV infected blood products for haemophiliacs in the 1990s. Until 1999, 1,434 patients were infected with HIV due to contaminated blood products, of whom 631 died.

The current Japanese Drug Safety approach is harmonized with ICH requirements where, each newly marketed product goes through the re-examination procedure at 8-10 years and then re-evaluation on an ad-hoc basis. The legal framework governing medicinal products in Japan is made up of one main law, supported by a cabinet ordinance, a ministerial regulation, ministerial ordinances and numerous notifications.

The main Japanese law governing medicinal products and medical devices is the "Law on Securing Quality, Efficacy and Safety of Pharmaceuticals, Medical Devices, Regenerative and Cellular Therapy Products, Gene Therapy Products and Cosmetics". The most important Ordinance governing Drug Safety in Japan is the "Ministerial Ordinance on Good Vigilance Practice for drugs, quasi-drugs, cosmetics and medical devices (MHLW Ministerial Ordinance No. 135 of 2004, known as the "GVP Ordinance", last amended in 2014.

The second most important ordinance is the "Ministerial Ordinance on Good Post-Marketing Study Practice for Drugs" (MHLW Ministerial Ordinance No. 171 of 2004).

5. Thailand: Drug Safety system in Thailand was given establishment in 1983. The national center was established under the Food and Drug Administration with ADR monitoring program as its main focus. Starting from 176 total reports by several tertiary hospitals during the first year, the number of reports is now more than 50,000 annually with pharmacists as a major reporter. Today the scope of work has been expanded to cover all health products and to involve various stakeholders in health system including consumers, market authorization holders, as well as, health facilities, i.e., drugs stores, physician clinics, private hospitals, and all levels of public hospitals, ranging from community hospitals to tertiary hospitals to academic and research hospitals.

Although the role of the national center has been well accepted, the extent of drug safety system and functions is being extended beyond its initial responsibilities. Collaboration among stakeholders as well as supporting their demands on patient safety becomes vital challenges influencing system effectiveness. Influx of health information due to the advancing of information technology and health products from the free trade area is another challenge to the system. Enhancing system performance is requiring coordination and integration of all concerned parties not only nationally but also internationally.

Knowing which stage the country is presently now is the initial reference to move the country's system forward. Learning from certain Asian countries with comparable resources is the next advantage for Thailand to cooperate as well as collaborate to strengthen each own drug safety system and risk management practices. The information and learning experience gained from the various projects of USAID in the country not only benefitted Thailand being studied but could also provide foundation and concepts of drug safety and risk management system for others.

C. Comparison Analysis of Drug Safety Systems across National Regulatory Authorities (NRAs)

Regulatory Requirements	**Stringent NRAs**		**Asian Competent / Reference NRAs**		
	US FDA	**Japan**	**China**	**India**	**Singapore**
Drug Safety Regulations	FD & C Act 1938; FDA Modernization Act 1997; FDAA 2007; FDASIA 2012; 21 CFR	Pharmaceutical Affairs Law; MHLW Ordinance No.135 of 2004; GVP and Good Post-Marketing Study Practice (GPSP)	Drug Administration Law 1984; Regulations for Implementation of Drug Administration Law 2002	Drugs and Cosmetics Act 1940; Drugs and Cosmetics Rules 1945 (Schedule Y)	Medicine Act Chapter 176, 1977
Mandatory industry reporting of serious ADRs	Yes				
Clinical Trials Register Exist	Yes (clinicaltrials.gov)	Yes (Japic CTI)	Yes (Chi CTR)	Yes (CTRI)	Yes (HSACTR)
Monitoring Period for New Drugs Required	Yes (5 years)	Yes (4–10 years)	Yes (5 years)	No	
Expedited Reporting of Serious ADRs for marketed drug required	Yes (15 Days)				
PV Inspection and Audits Required	Yes		No		
Risk Management Plans Mandated (RMP)	Yes	Yes	No		No (however applications should include RMP or REMS)
Spontaneous Reporting Database Exist	FDA Adverse Event Reporting System (FAERS), VAERS database	ADR information management system	National ADR Monitoring System	Vigiflow provided by UMC is used under Drug Safety Program of India (DSPI)	No
Periodic Safety Update Reports Required (Frequency)	Yes (every 3 months for first 3 years)	Yes (every 6 months for the first 2 years)	Yes (annually for the first 5 years)	Yes (every 6 months for the first 2 years and then annually thereafter, but applicable only to "new drugs, until 4 years	Yes (every 6 months for the first 2 years)

				after launch")	
Active Surveillance Initiative	Sentinel System	MIHARI Project	No		

D. Biggest Pharmaceutical Markets in the World by Country

Rank	Country	Value of Pharmaceutical Market (in million $)
1	USA	339,694
2	Japan	94,025
3	China	86,774
4	Germany	45,828
5	France	37,156
6	Brazil	30,670
7	Italy	27,930
8	UK	24,513
9	Canada	21,353
10	Spain	20,741

**As of 2016-17*

E. Country wise Exports of Drug and Medicine

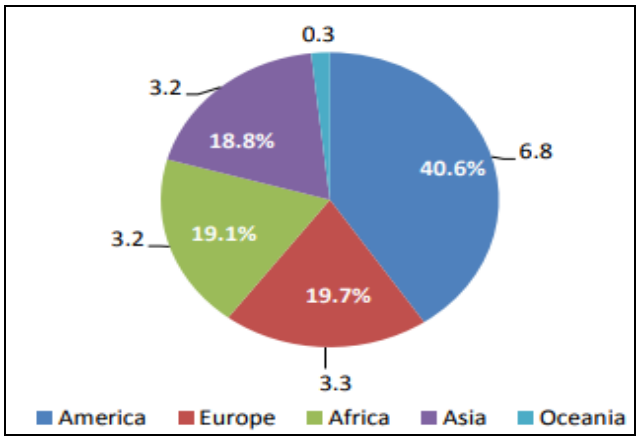
Below is the list of top 15 countries that exported the highest dollar value worth of drugs and medicines during 2016-17:

Rank	Country	Value of Exports (US$)	Percentage
1	Germany	48.6 Billion	15.3% (of total exported drugs and medicine)
2	Switzerland	39.9 Billion	12.5%
3	Belgium	26.5 Billion	8.3%
4	France	22.8 Billion	7.1%
5	United States	22.5 Billion	7.1%
6	United Kingdom	22 Billion	6.9%
7	Ireland	19.8 Billion	6.2%
8	Italy	16.6 Billion	5.2%
9	Netherlands	15.5 Billion	4.9%
10	India	11.6 Billion	3.6%
11	Spain	7.5 Billion	2.3%
12	Canada	7.4 Billion	2.3%
13	Sweden	5.6 Billion	1.8%
14	Austria	5.3 Billion	1.7%
15	Israel	3.9 Billion	1.2%

The listed 15 countries above shipped altogether 86.5% of all drugs and medicine exports in 2016 (by value).

F. Continent wise Exports of Drugs and Pharmaceuticals in 2016-17 (USD Billion)

Of the total exports of USD 16.8 billion during the year 2016-17, majority of the exports, accounting for 40.6% were to the American continent followed by 19.7% to Europe, 19.1% to Africa and 18.8% within Asia.



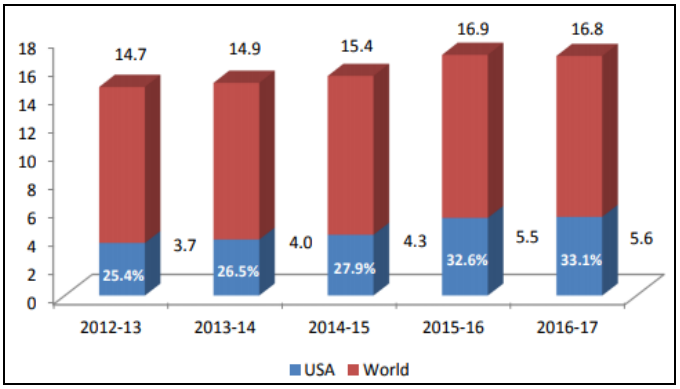
Significance of USA in Indian Pharma Exports (A Major Export Destination)

Among the countries, United States of America is the primary export destination for India. Exports to USA have been on a rise since more than a decade. The exports are mainly driven by the cost advantage that India has. The share of exports to USA in total drugs & pharma exports from India which was 25.4% in 2012-13 increased to 33.1% in 2016-17. For other countries like UK, South Africa, Nigeria, Russia, Brazil, Germany, Australia, the share of each of these countries in total drugs & pharma exports remained in the range of 1.4%-3.3% in 2016-17.

In 2012-13, exports to USA grew by 14.2% y-o-y to USD 3.7 billion and increased in single digit in each of the following two years. In 2015-16, exports to USA surged by 27.8% to USD 5.5 billion on a y-o-y basis. However, the export scenario to USA weakened and it grew by a marginal 1.3% to USD 5.6 billion in 2016-17.

The prime reasons for the weak exports were price erosion in the generic market in USA due to consolidation among customers i.e. the distribution channels, increase in competition, absence of blockbuster drugs going off patent and regulatory issues faced by Indian Pharma companies.

This situation continued even during the initial months of the current financial year 2017-18 and exports to USA declined by 23% y-o-y to USD 723.4 million during April-May 2017. The total exports from India during the same period fell by 8.5% to USD 2.5 billion.



Pharmaceuticals Exports by India and share of USA in total exports (USD Billion)

III. SOUTH INDIAN SCENARIO IN DRUG SAFETY AND RISK MANAGEMENT

India through its South Indian states (Andhra Pradesh, Karnataka and Tamil Nadu) is now considered to be a hub for clinical research and other allied drug safety related activities. The Drug Controller General of India (DCGI) has shown its commitment to ensure safe use of drugs and sustainability risk management practices by establishing the National Drug Safety Program. More and more clinical trials and vast research activities are now being conducted in southern states and business process outsourcing (BPOs) based in these three states are now also undertaking drug safety projects from MNCs. Healthcare professionals, consumer groups, NGOs and hospitals are appreciating that there is now a collective system in place to collect and analyze adverse event data. The people have started reporting adverse events actively and participate in the National Drug Safety Program to help and making ensure that people in India receive safe drugs. With the help and proper coordination of all stakeholders, the states are definitely trying to build a world class drug safety and risk management system in India.

Focusing one growth driven state, Karnataka is one of the fastest growing states in terms of the pharmaceutical sector in India. The state occupies the fifth position in the pharmaceutical exports. Around 40% of the state's pharma produce is exported overseas. The state contributes about 10% to the pharmaceutical export revenues of the country.

Karnataka is among the top ten states that are known to have the maximum number of pharma manufacturing units in the country. The state has 221 formulation units and 74 bulk drug units. They account for 3% of India's pharma manufacturing units. Karnataka has gained recognition the world over for its pharma manufacturing capabilities. The state boasts of several modern pharma plants that are on par with global standards and international regulatory certifications. Karnataka is witnessing a steady growth and expansion of the pharmaceutical industry due to number of factors, such as:

a. Presence of large number of reputed and globally recognized pharmaceutical companies in the state
b. Presence of several advanced R&D Centres, exclusive pharma SEZ, and pharma industrial zones in state
c. Availability of natural resources and skilled manpower
d. World-class technology and infrastructure etc.

A. Need of Drug Safety Education and Training in India

Adequate research, required development of the new molecule in most exquisite laboratories and most out reaching marketing techniques do not suffice for a drug manufacturing company to bid adieu to the launched drug. A drugs journey in the market, its stay and success in the same market and others is to be necessarily closely monitored and reported by the drug companies. This phase of a drugs lifecycle is called drug safety.

With emphasis on drug safety, there appears huge need for adequately qualified and trained professional who could understand and take up post marketing surveillance roles in drug companies. Thus, there occurs a need of team of drug safety officers. Clearly this need is proportional to the number of new drugs being launched every year which is always increasing. Several courses are being offered to develop quality manpower in the field of drug safety and its management:

a. Executive Diploma in Clinical Research
b. Postgraduate Diploma in Drug Safety
c. Executive Diploma in Drug Safety
d. Postgraduate Diploma in Clinical Data Management
e. Executive Diploma in Clinical Data Management

IV. GROWTH PROSPECTS IN PHARMACEUTICALS AND LIFE SCIENCES IN INDIA

India's population is growing rapidly, as is its economy – creating a large middle class with the resources to afford Western medicines. Further, India's epidemiological profile is changing, so demand is likely to increase for drugs for cardio-vascular problems, disorders of the central nervous system and other chronic diseases. Together these factors mean that India represents a promising potential market for global pharmaceutical manufacturers.

More than that, India has a growing pharmaceutical industry of its own. It is likely to become a competitor of global pharma in some key areas, and a potential partner in others. Global players in the pharma industry cannot afford to ignore India. The country, many predict, will be the most populous in the world by 2050. India will make its mark as a growing market, potential competitor or partner in manufacturing and R&D, and as a location for clinical trials.

Elsewhere, Indian companies have adopted various strategies to stay afloat during the crisis, including greater focus on leveraging their strengths in newer structures like Contract Research and Manufacturing Services (CRMS), Biotech and Clinical Trials and increasing penetration in rural markets. Few of the growth driven factors are mentioned below:

1. Contract Manufacturing:

Contract manufacturing is a strong segment of the domestic market. Indian firms have several advantages over their Western rivals. The expertise gained in manufacturing generics through reverse engineering has helped some companies streamline the process for getting manufacturing up and running.

Some Indian manufacturers are also now incorporating Lean Manufacturing and Six Sigma principles to help them boost operational efficiency and further improve quality, while facilitating compliance. The key drivers among others for rise in Pharma contract manufacturing are:

- Dwindling profit margins in highly competitive global Pharma marketplace.
- Growing demand for generic drugs; patent expiration of major therapeutic brands.
- Demand for up-to-date processes
- Need for high-quality R & D facilities and cost-effective production technologies that meet global regulatory requirements (especially as current manufacturers are forced to move out of many antiquated plants in the west).
- Government initiatives in the healthcare sector.
- Innovation in biologics and high potency API, and
- Finally, escalation in the incidence and rate of growth of diabetes, cancer, cardiovascular diseases and psychological illnesses.

The road ahead – Challenges and Opportunities

The contract manufacturing in Pharma business setting has never been more challenging and interesting at the same time. Challenging, due to the complex and unique interplay of ever increasing factors that increase the gap between strategic vision and operational reality and interesting, as companies intrepidly aspire and venture to be the part of the growth story despite the local and global challenges.

India, along with Brazil & China, has earned a place for itself as a top generic Pharma player in the export market to the developed western countries by producing and supplying superior quality pharmaceuticals that come with reasonable pricing.

2. Massive Potential of OTC Market:

Globally, over-the-counter (OTC) drug sales have been increasing in recent years. This trend is driven in part by aggressive efforts of global pharma companies to leverage the brand equity that major products have attained during the patent period.

The Government is now considering plans to expand the list of drugs which can be sold outside pharmacies, since many common household remedies are more difficult to obtain in India than in other developing countries. An expansion of the list would substantially increase the potential market opportunity in this segment.

Indian consumers are also placing more emphasis on prevention and wellness, which should contribute to continued increases in sales of OTC vitamins and minerals. The market is already growing strongly. Profitable OTC drugs for some of India's largest pharma companies include artificial sweeteners, emergency contraceptive pills and nutritional supplements.

Pharma companies are also targeting post offices to sell OTC drugs in rural India. This move could substantially increase the access of OTC drugs, especially in areas where there are no pharmacies.

3. Reaching the Untapped Rural Market:

Although urbanization continues, around 70% of India's population still resides in rural areas. As already noted, the population residing in villages has significantly reduced access to quality treatment and medicines. Many pharma companies are thinking beyond larger cities and targeting rural sectors. While urban markets are currently more lucrative and will continue to represent a focus for the industry, the untapped potential of Indian rural markets is now seen as the next volume driver. Rising income levels leading to more affordability, improving health infrastructure, and increasing incidence of lifestyle diseases along with the use of health insurance are fuelling the growth in rural areas.

Indian companies are devising a number of strategies to increase rural penetration. For instance, Lupin has a strong brand franchise in the anti-infective, pain management, and gastrointestinal segments – these three areas account for 40% of domestic formulations sales. The company has a dedicated rural field force of more than 300 people and is rapidly expanding it.

Companies looking to access rural markets face many hurdles, including lack of communication, language barriers, high

penetration of spurious drugs, lack of adequate infrastructure, such as marketing and distribution channels for niche therapeutic segments in particular, poor storage facilities, and insufficient sales personnel deployment. Global pharma companies eyeing rural markets will need to forge alliances and partnerships to overcome these obstacles.

4. Biotech and Biosimilars on track for Growth:

India is home to a small biotechnology industry, based largely in Karnataka, with other clusters of activity in West Bengal, Maharashtra, Andhra Pradesh, Hyderabad, Kerala and Ahmedabad. In 2008-09, the sector generated sales of US$2.64 billion93 representing a CAGR of 26%, but both the federal and state Governments have been actively promoting biotech research initiatives.

The leading domestic players include Serum Institute of India, which focuses on immuno-biologicals and vaccines; Biocon, which concentrates on recombinant DNA technologies, bioprocesses, fermentation-based small molecules and enzymes; and Panacea Biotech, which specializes in novel drug delivery techniques and pharmacogenomics.

Several initiatives have been launched by the Government to give impetus to the thriving biotech industry. The Biotechnology Industry Partnership Programme (BIPP) has been launched by the Department of Biotechnology (DBT) to support high-end biotechnology research programmes capable of generating globally recognized intellectual property. It specifically focuses on transformational research and development (R&D) growth of the sector.

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V. DRUG SAFETY OUTSOURCING – POTENTIAL FUTURE ROAD MAP OF INDIA

Clearly, the present state of Drug Safety outsourcing is significantly skewed towards ICSR (Individual Case Safety Reports) related work, which forms the largest piece of Drug Safety value chain pyramid.

However, interestingly over the last decade or so, with advanced technological innovations, standardization and harmonization of processes, and geographical optimization of talent and scale, this segment has moved more into commoditized and industrialized zone. While the growth of this segment would continue to depend heavily upon economy of scale for its profit sustainability, the future state; especially in the context of increasing pressure on cost, competition and operational efficiency, would be essentially driven by advanced automations/robotics as effective & seamless delivery solutions augmented with better coverage for ever changing global Drug Safety regulatory landscape and operational agility to manage unpredictability of volume, velocity and variation of safety world.

Apart from ICSR related work, it's the high end, niche safety services such as safety aggregate reporting, safety signal and benefit-risk management related functions which would be instrumental in defining the future road map for Drug Safety outsourcing in India. The real key for future differentiation lies in investing and scaling up capabilities for these highly knowledge rich and science driven functions. Organizations with this hybridized delivery model and focus on talent building, leadership, innovations and appropriate balance between science and mathematics of Drug Safety operations would be able to rightly position their authorities on the greater success of future Drug Safety outsourcing.

In the context of Biosimilars, the government plans to allocate US$ 70 million for local players to develop Biosimilars. The domestic market is expected to reach US$ 40 billion by 2030.

VI. CONCLUSION

For all medicines there is a trade-off between the benefits and the potential for harm. To minimize the harm, it is necessary that medicines of good quality, safety and efficacy are used rationally, and that the expectations and concerns of the patient are taken into account when therapeutic decisions are made. To achieve this is to serve public health, and to foster a sense of trust in patients in the medicines they use that would extend to confidence in the health service in general.

The discipline of Drug Safety has developed considerably since the 1972 WHO technical report, and it remains a dynamic clinical and scientific discipline. It has been essential to meet the challenges of the increasing range and potency of medicines (including vaccines), which carry with them an inevitable and sometimes unpredictable potential for harm.

The risk of harm, however, is less when medicines are used by an informed health profession and by patients who themselves understand and share responsibility for their drugs. When adverse effects and toxicity appear - particularly when previously unknown in association with the medicine - it is essential that they should be analyzed and communicated effectively to an audience that has the knowledge to interpret the information, this is the role of Drug Safety and Risk Management. Much has already been achieved but more is required for the integration of the discipline into clinical practice and public policy.

The best practices in Drug Safety and Risk Management will come across a fruitful stage when government along with all private stakeholders including local and international pharmaceutical and drug safety organizations will put up the initiative to promote better sustainability, economic generation and provide better and healthy livelihood to the community.

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REFERENCES

[1] Pharmacovigilance and Risk Management Article; Chapter 13; https://www.elsevier.com/

[2] Review Article –Strategies and Current Scenario of Pharmacovigilance in India- 2014; ISSN: 2348-3792

[3] http://www.careratings.com; pp-3-4

[4] Article- A Study on Drug Safety Monitoring Program in India; Sep-Oct 2014

[5] Article- Advances in Pharmacoepidemiology and Drug Safety; ISSN: 2167-1052; May 2014

[6] Article- Pharmacovigilance: A Worldwide Master Key for Drug Safety Monitoring; Jul-Sep:315-320

[7] https://www.ibef.org/industry/pharmaceutical-india.aspx

[8] White paper- Challenges in Global Pharmacovigilance; www.arisglobal.com

[9] Article- Roadmap to Risk Evaluation and Mitigation Strategies (REMS) success; Oct, 2010

[10] Article- Drug Safety Surveillance in China and Other Countries: Review and Comparison; Vol. 02, Sept.2008

[11] http://www.diaglobal.org/productfiles/22993/

[12] Article- A Drug Safety Risk Management and Assessment Mechanism in Taiwan; Feb.2010, She- I Chang & Guo-Yao Hung

[13] Article- Contract Manufacturing in Pharma- India; Jul.2017; MVN Nagalakshmi & Dr. Ravi N. Thodia

[14] https://www.pwc.com/gx/en/pharma-life-sciences/pdf/global-pharma-looks-to-india

[15] https://www.ibef.org/download/Pharmaceutical-July-2017

[16] https://www.linkedin.com/pulse/pharmacovigilance-outsourcing-india-a-potential-road-map-shastri-md

[17] Article- Pharmaceutical industry in Karnataka; Feb.2017, Raggi Mudde

[18] Article- Drug and Medicine Exports by Country; Jan.2018; Daniel Workman

[19] Article- Pharmacovigilance: A Step towards Drug safety; Oct.2014; IJLBPR Vol.3; Lokesh Patil & Dattatri AN

[20] Article- Pharmacovigilance Responsibilities of medicine sponsors; Sep.2017;Australian Government