J. Pharm. Tech. Res. Management Vol. 10, No. 2 (2022), pp.149–155

CHITKARA

Journal of Pharmaceutical Technology Research and Management

Journal homepage: https://jptrm.chitkara.edu.in/

Comprehensive Regulatory Framework in Current Advancements of Medical Devices

Hirishita Dhawan[1*], Priyanka Gupta[2] and Anjoo Kamboj[3]

[1]*Chandigarh College of Pharmacy, Chandigarh Group of Colleges, Landran, Punjab - 160019, India*

[*]hirishita1998@gmail.com (Corresponding Author)

ARTICLE INFORMATION

Received: July 22, 2022
Revised: August 26, 2022
Accepted: September 23, 2022
Published Online: November 10, 2022

Keywords:
Technology advancement, Current Regulatory Standards, Market Trends

DOI: 10.15415/jptrm.2022.102005

ABSTRACT

Background: A medical device is any tool, implant, or IVD that is intended to manage, ameliorate, avert, or identify a human disease. Simple thermometers, bandages, implants, and so on are examples. A medical device's primary intended use is not accomplished chemically on or within the skin, nor does it require metabolization to accomplish that primary intended use. Medical devices are classified differently by different regulatory bodies. The FDA divides medical devices into three categories, whereas India and Europe divide them into four categories based on risk. Each regulated country has its own set of medical device regulations and guidelines.

Purpose: The medical device sector is expected to showcase a remarkable journey of growth by 2029, achieving a 718.92-billion-dollar market with a CAGR of 5.5% over the expansion period of 2022–2029, making it the fastest-growing global market. The earlier medical device has simple inspection and testing but Post Covid19 due to an increase in imports, takeover from foreign manufacturers, and fostering innovation medical devices took off, becoming ever more sophisticated and widely available therefore the need for manufacturing and product standards was recognized, the new regulation was framed and regulatory specialists were recruited. Thereby led to the emergence of a whole new regulatory system and a post-marketing surveillance strategy.

Methods: The analysis of current market size, share, and trends on medical devices for USA, Europe, and India was performed and current regulatory standards were observed which are continuously becoming stringent for all the countries with the advancement of technology.

Conclusions: The Medical devices sector is the leading growing market. With the advancement in the medical device sector such as cybersecurity, digitalization, data privacy, and innovation, new entrants and new manufacturers the doors for entrepreneurship will open thus, it becomes highly important and necessary to introduce comprehensive regulatory guidelines for safety, effectiveness and customer protection, and satisfaction. The regulated medical devices sector will reach new heights with stringent vigilance and transparency benefitting society.

1. Introduction

The Medical Device industry is emerging as the fastest-growing global market and has the potential to grow at a CAGR of 5.5% by 2022 – 2029 and is expected to grow from 495.46 billion$ to 718.92 billion$. Ranging from a simple thermometer, surgical mask, and band-aid to implants, pacemakers, and ventilators, the multifarious product industry of medical devices is worth over USD 220 billion. The COVID-19 epidemic created abundant chances for both current market participants and newcomers. Post-pandemic there is a worldwide exponential growth and expansion of the medical device industry.

In the USA, the market potential of the medical device sector is estimated to show exponential growth from 186.5Billion $ in 2021 to contrive profits of about 262.4 Billion dollars in 2028. The market size in India of the medical device sector through sales is projected to rise at a rate of about 15–17% CAGR. The earlier medical device has simple inspection and testing but Post Covid19 due to an increase in imports, takeover from foreign manufacturers, and fostering innovation medical devices took off, becoming ever more sophisticated and widely available therefore the need for manufacturing and product standards was recognized, the new regulation was framed and regulatory specialists were recruited. Thereby led to the emergence of a whole new regulatory system and a post-marketing surveillance strategy. A voluntary quality assurance system was also set up to improve design and production.

In India, regulation of medical devices has been set as a separate category and not as a drug have finally been laid out under a draft 'Drugs, Medical Devices and Cosmetics Bill, 2022' released by the MoHFW for public consultation. The

ISSN No.: 2321-2217(Print) ISSN No.: 2321-2225(Online); Registration No. : CHAENG/2013/50088

draft bill also proposes creating a technical advisory board for the same, State and Central testing labs for medical devices, allowing the central government to make rules regulating online pharmacies, appointing medical device officers to look at clinical trials, and requiring licenses for the sale of devices. India's MoHFW finalized an amendment to the Medical Device Rules, 2017 (MDR 2017). This guidance concerning the suspension and cancellation of licenses is known as the Medical Devices (Third Amendment) Rules, 2022, and the requirement to obtain a registration certificate to sell any medical devices (Fifth Amendment) Rules, 2022. Also in Europe, Medical Devices Regulation (EU) 2017/745 has taken the role of Medical Device Directive (93/42/EEC) introducing reclassification of Medical Devices (introduction of 4 risk-based classes), Extended Medical Devices definition, UDI, EUDAMED thereby regulating medical devices. The alignment of regulations by the USFDA with the advancement and innovation occurring in the MedTech sector such as modifying its Quality System Regulation (QSR), current good manufacturing practice (cGMP) criteria for medical devices, framing regulations for cyber security and data AI/Machine Learning.

This paper covers the Current Status of the Medical Device Industry Sector - Market Size, Share & Trends Analysis, current regulatory advancement in regulations of medical devices mainly in India, the USA, and Europe, and the need to frame and implement the stringent regulatory standard, regulate market access and policy for old and new entrant for patient safety and consumer protection.

2. Medical Device Industry Sector Current Status - Market Size, Share & Trends Analysis

The current Medical Device sector is burgeoning with many innovative and competitive Medical Devices with mushrooming of small and medium-sized enterprises as the market of this sector is expected to project in 2022-2029, at a CAGR of 5.5%, to reach 718.92 billion dollars by 2029. The market size of a medical device is estimated to be USD 186.5 billion in the USA, marked by Europe at USD 140.07 billion.

Table 1: Medical Device Manufacturers Market Report Scope (USA, Europe, India).

Country	USA	EUROPE	INDIA
Market size value	186.5 Billion USD	140.07 Billion USD	15 Billion USD
Revenue forecast	262.4 Billion USD	171.19 Billion USD	50 Billion USD
Expansion rate	5.0% CAGR from 2021 - 2028	4.09% CAGR from 2022 - 2027	15% CAGR from 2019 - 2025
Projection period	2028	2027	2025
Market units	CAGR between 2021 -2028 & Revenue in billions of dollars	CAGR between 2022 -2027 & Revenue in billions of dollars	CAGR between 2019 -2025 & Revenue in billions of dollars

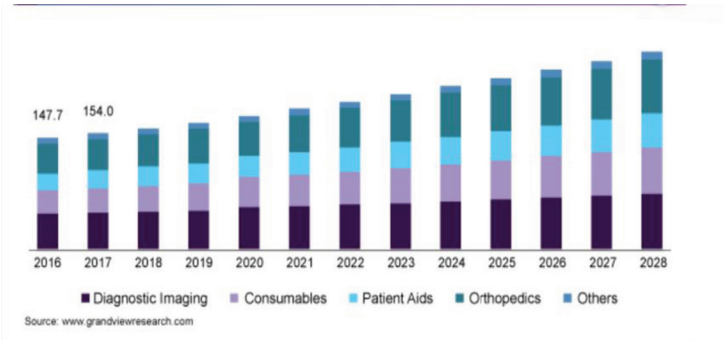

Figure 1: By type, 2016 to 2028(USD Billion) Market size of the US medical device.

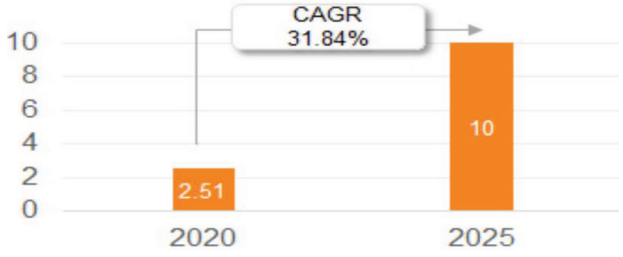

Figure 2: In India 2020 – 2025, Medical Devices Export Market**.**

Current Trends in Medical Devices

The COVID-19 virus has caused a humanitarian crisis unlike any other, with approximately 2 million people affected and tens of thousands of fatalities. The pandemic's disruption revealed hitherto unknown difficulties for society and the economy around the world.The Healthcare industry witnessed a major shortage during the unparalleled demand for even the basic Class 1 medical devices likesurgical masks, sanitizers, and medical gloves. Further manufacturing capacity and capabilities were questioned for the inadequate availability of ventilators, oxygen cylinders, PPE kits, and other medical supplies. Although the MedTech sector's actions during this period saw an expansion of boundaries to investigate creative ways to more fully complement capability, such as partnerships with businesses outside the industry, ASCII text file instrumentality style, and preparing medically educated people to help overcome the challenges. Further recognizing the areas of risk and opportunity, a new era of innovation in the MedTech sector to boost the standard of care while keeping prices low is booming worldwide. The need for medical device software for tracking, monitoring, and producing data for analysis related to the pandemic is also realized. Better treatment and early diagnosis with more efficiency and precision can be expected with the progression of computer science and machine learning (AI/ML). With this growth, there are challenges to digital advancement in care that embrace the prices and complexity of the latest technologies, the requirement for education/ innovation and cyber security, and stringent regulations and guidelines. The following current trends in medical devices have new guidance, regulations, and drafts proposed by the regulatory authorities.

1.1. Wearable Devices – Growing Customer Preference

The rising concern for health among the population has marked the increased demand for wearable devices. Also, with the new model and features coming the customer pool is more attracted thereby increasing the need for data privacy and security and regulations for protection. USFDA has also considered the importance of cybersecurity and quality in medical devices. Thus, if any medical device company develops a wearable product compliance with FDA 21 CFR Part 820 and ISO 13485 is necessary.

1.2. Growing Incidence of Chronic Illnesses will Increase Demand for Medical Equipment

The increase in chronic diseases such as diabetes, cancer, and heart disease have increased the demand for coronary implants and pacemaker (Class 3 medical devices). For high-risk level, Class 3 medical devices the regulations thus followed for approval are:

- IDE Investigational device exemption (if clinical studies are required)
- Premarket approval (PMA)
- FDA approval
- General control for MD

1.3. Use of Software as a Medical Device

Today, cancer can be detected using Computer-Aided Detection (CAD) software, and images obtained from a magnetic resonance imaging machine can be viewed on a smart phone (MRI). Thus, when software is used for diagnostic purposes, it is referred to as the SaMD. The SaMD risk category is divided into four categories (I, II, III, and IV). These classifications are based on the patient's health severity, where precise information provided by the software as a medical device to treat, guide, or manage clinically that is essential to prevent death, disfigurement for an extended time, or other grave health deterioration, mitigating public health. The USFDA regulates SaMD, and the Cures Act 2016 amends existing policies for Medical Software.

1.4. High Cost of Medical Devices in Emerging Countries

New technology and design modifications in medical devices, as well as a large number of imports from the United States, Europe, and China, make it critical to regulating medical device prices in developing countries. Prices for medical devices should be regulated to increase accessibility, availability, and adoption in developing countries.

In India, the DPCO 2013 regulates the price of medical devices such as coronary stents, if the price of a medical device exceeds 10% of the previous 12 months' prices for the remaining medical devices not covered by NLEM, the NPPA is authorized to monitor their MRPs and impose sanctions on producers.

2. Current Regulatory Standards in Europe

In Europe, the medical devices sector is burgeoning with different types of competitive and innovative medical devices with mushrooming of various small and medium-sized enterprises. It is regulated by the legal framework of directives and council decisions to deliver the highest level of protection and safety in public health by ensuring the product of good quality and efficacy. Medical devices were previously governed by Directive 93/42/EC, which has since been superseded by MDR (EU) 2017/745. Previously, medical device regulatory procedures relied on Medical

Device Directives (MDD), which are made up of three core directives that have been amended for the safe regulation and marketing of medical devices.

EU 2017/745 is the current law that replaced Directives 90/385/EEC Active Implantable and 93/42/EEC Medical Devices. It was published on April 5th, went into effect on May 25th, and was applied across the European Union on May 26th, 2021. Furthermore, Regulation (EU) 2017/746 In Vitro Diagnostic Medical Devices replaced Directive 98/79/EC. The MDR (EU) 2017/745 adds or updates EMA's duties in the following areas:

- Pre-filled syringes, pens, and inhalers are examples of medications with integral devices.
- Other examples include medical devices that contain an accessory medicinal material to support the device's proper operation. Examples include drug-eluting stents, antibiotic-laced bone cement, heparin- or antibiotic-coated catheters, and spermicide-coated condoms.
- Other examples include medical devices made from materials that are absorbed by humans to serve their intended purposes, as well as products that are on the regulatory edge. Common distinctions between pharmaceuticals, cosmetics, herbal remedies, medical equipment, biocidal products, and dietary supplements.

Table 2: Comparison of IVDR (EU) 2017/746 and IVDD 98/79/EC.

	IVDD 98/79/EC	IVDR (EU)2017/746
Legislative Framework	Directive: Requires transposition in each member state	Regulation: Immediately applicable by law in all member states
Pages	37	157
Articles	24	113
Annexes	10	15
Notified body	80-90% of the product do not require NB intervention	80-90% of the products require NB intervention

On October 14, 2022, the European Medicines Agency (EMA) published an updated Regulatory and procedural guideline: European Medicines Agency guidance for applicants seeking advice and protocol assistance. This makes it easier for the developer to develop its medicine by identifying questions and potential solutions. The EMA then provides advice on developer proposals. This assists the orphan medicine developer with scientific advice related to the authorization of an orphan medicine.

3. MedTech & Advancement in Regulations of medical devices in the USA

The USFDA serves as the primary access point for various countries and global large organizations to access information related to public health rules, regulations, guidelines, and policies, which are updated, amended, and regulated regularly in response to technological healthcare system advancements. The United States is currently the world leader in medical device manufacturing, exports, sales, and market expansion. The medical device sector, which is regulated by the USFDA - CDRH in the United States, thus bears a great responsibility to align regulations with the advancement and innovation occurring in the MedTech sector.

AI/Machine learning – Digital Health using Medical Devices

AI/machine learning in medical devices helps improve the healthcare system & patient experience as is more convenient to use, easy health monitoring, and personalized healthcare can be achieved. New digital health monitoring systems such as heart rate, sleep cycle tracker, diet tracker, and menstruation cycle trackers. Smart watches have these features are easy to wear, safe to use, and affordable thus their impact is increasing in the current healthcare system. Machine learning (ML) is used in medicine, particularly in disease prediction. In 2018, it was used to develop IPU-M, a high-precision model for predicting rebleeding of idiopathic peptic ulcers. These AI/Machine Learning devices are high-risk medical devices and thus needs to be regulated with stringent regulations and approval process.

USFDA has to focus more on framing stringent guidelines on the following factors for AI/Machine Learning based medical devices such as:

Figure 3: Cyber security – Current concern for medical device safety.

Since innovation is currently leading the medical device sector, the USFDA is focusing more on digitalization, cyber security, and data privacy. The Agency's primary focus is on device software functions because patients are at risk if their data is not secure, such as in mobile medical apps, as explained in the recently updated Policy for Device Software Functions and Mobile Medical Applications Guidance. The primary concern is the failure of medical device software in smart phones, computers, or other mobile platforms.

The USFDA has issued several new cyber security guidelines for medical devices: System Qualitative Factors The most recent Premarket Submission for Management of Cyber security in Medical Devices (Annex I) included QSM (Quality System Management), QRM (Quality Risk Management), IT, operation, and Information Security in the medical device cyber security framework. Further vulnerability testing is introduced as an advanced function in malfunction detection.

Figure 4: Cyber security in medical devices (MDR Annex I).

4. Current Advancement in Regulations of medical devices in India

One of the nation's most important growing healthcare industries is the medical device sector in India after COVID-19. It is expanding quickly, averaging 15% annual growth, and is predicted to reach 50 billion$ by 2025. In India, medical equipment and appliances make up the largest category (34%) followed by diagnostic imaging tools (31%), supplies and implants (19%), and patient aids and miscellaneous items (16%) all governed by the CDSCO Medical Devices and Diagnostics Division. The exponential growth in this sector created the necessity for stringent regulations, well-structured planned schemes, acts & guidelines for the regulatory structuring of the medical devices sector in India.

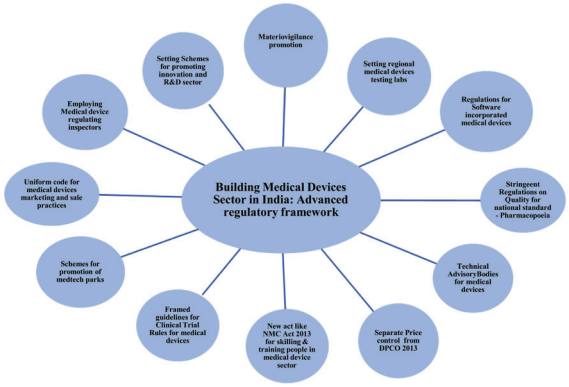

Figure 5: Building Medical Devices Sector in India: Advanced regulatory framework.

Introduction of amendments in Medical Device Rules 2017

The"Medical Devices (Amendment) Rules, 2020" were updated by the Indian Medical Device Regulation (IMDR) in February 2020 and went into effect in April 2020. The regulations amended in Medical Device Rules 2017 were the mandatory registration for manufacturing, import, labeling, and sales, specified in newly added Chapter IIIA, the introduction of four different risk-based classes of medical devices: Class A, B, C, and D.

Drafting of Drugs, Medical Devices and Cosmetics Bill, 2022

Recently, regulation of medical devices has been set as a separate category and not as a drug, and a new draft 'Drugs, Medical Devices and Cosmetics Bill, 2022' has been released by the Ministry of Health and Family Welfare for public consultation. Released on July 8th, the bill also proposes creating a technical advisory board for the medical device sector, State and Central testing labs, allowing the central government to make rules regulating online pharmacies, appointing medical devices officers to look at clinical trials, requiring licenses for sale both (offline and online) for devices. Major provisions in the drafted Drugs, Medical Devices and Cosmetics Bill, 2022' are:

- Setting standards for gadgets: Performance, quality, and safety requirements for such devices
- Regulations governing the sale and licensing of devices
- Authority of the Medical Device Testing Officer
- Laws governing "clinical studies"

The initiative by the Government of India (GoI)

Considering the huge growth potential in the medical device sector GoI included the medical device sector in the "Make in India" initiative and thus many new opportunities have been introduced for the further development and expansion of the sector such as:

- Investment in MedTech Park Schemes (Hyderabad & Vizag) of Rs. 1.6 LAC Cr
- Establishment of the Indian Biomedical Skills Development Council
- Price Caps on Stents & Knee Implants
- Bio valley, IKP, C-CAMP, and Medi valley establishment
- 1200 Technical collaboration @5 M (40 Cr. RS) for Indian investors
- 200 Joint Venture @10 M (80 Cr. RS) by overseas foreign investment

Conclusion

The Medical devices sector is the leading growing market. With the advancement in the medical device sector such as cyber security, digitalization, data privacy, and innovation, new entrants and new manufacturers the doors for entrepreneurship will open thus, it becomes highly important and necessary to introduce comprehensive regulatory guidelines for safety, effectiveness and customer protection, and satisfaction. The regulated medical devices sector will reach new heights with stringent vigilance and transparency benefitting society.

Future Prospective

It is likely that as technology develops, new, stringent government regulations will form and a new phase of medical devices will emerge with a greater focus on safety, efficacy, and protection. There will be an increased impact on patient safety and treatment. Future studies can examine the additional effects and benefits that new regulations might have on global manufacturers and how they are currently coping with the change. Performing a deeper investigation should be made into how medical device regulators respond to and address new regulatory challenges.

Acknowledgments

I would like to express my gratitude to Chitkara University who allowed us to publish the article and to Chandigarh College of Pharmacy for the continuous support for writing the review article.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the article.

Abbreviations

IVDs: In Vitro Diagnostics; CDSCO: The Central Drugs Standard Control Organization; USFDA: United States Food and drug administration; CAGR: Compound Annual Growth Rate; USD: US Dollar; MoHFW: Ministry of Health and Family Welfare; PPE: Personal Protective Equipment; ASCII: American Standard Code for Information Interchange; AI: Artificial Intelligence; MI: Machine Learning; ISO: International Organization for Standardization; CFR: Code of Federal Regulations; DPCO: Drug (Price Control) Order; NLEM: National List of Essential Medicines; NPPA: National Pharmaceutical Pricing Authority; CDRH: Center for Devices and Radiological Health

References

Henry, K. (2022, June 20). Fortune Business Insights: Medical Device Market Size, Share & Covid Impact Analysis By Type, End-user and Regional Forecast. Retrieved October 4, 2022, from https://www.fortunebusinessinsights.com/industry-reports/medical-devices-market-100085

Austin, N. (2019, March 31). Grand View Research:U.S. Medical Device Manufacturers Market Size, Share & Trends Analysis Report By Type And Segment Forecasts. Retrieved October 4, 2022, from https://www.grandviewresearch.com/industry-analysis/us-medical-device-manufacturers-market/methodology

Thomas, L. (2022, May 31) News-Medical.Net: The Importance of Regulating Medical Devices, Retrieved October 4, 2022, from https://www.news-medical.net/health/The-Importance-of-Regulating-Medical-Devices.aspx

Shah, R., Anuja, K., & Goyal, K. (2008). Current Status of the Regulation for Medical Devices. *Indian Journal of Pharmaceutical Science,* 70(6), 695-700. https://doi.org/10.4103/0250-474X.49085

Sahadeva, A. (2022, June 21). Global Legal Insights: Pricing & Reimbursement Laws and Regulations EurAsian Matters. Retrieved October 4, 2022, from https://www.globallegalinsights.com/practice-areas/pricing-and-reimbursement-laws-and-regulations/india

Colhn, N. (2022, May 13) Market Data Forecast :Europe Medical Devices Market Research Report - Segmented By Type, End-user, and Country - Industry Analysis

on Size, Share, Trends, COVID-19 Impact & Growth Forecast. Retrieved October 4, 2022, fromhttps://www.marketdataforecast.com/market-reports/europe-medical-devices-market

The European Parliament And Of The Council, Official Journal of the European Union (2017). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R0745

Markan, S., Nath, R., & Sharma, J. (2020). Indian Medical Device Sector -Blue Print & Regulatory Policy Roadmap. *International Journal of Drug Regulatory Affairs,* 8(2), 25-35. https://doi.org/10.22270/ijdra.v8i2.392

Almir, B., Halida, A., & Gurbeta, P., (2021).Artificial Intelligence in Medical Devices: Past, Present, and Future.*Psychiatria Danubina* 33(3), 336- 341. https://doi.org/10.5005/sar-1-1-2-101

Venugopal, N., Senthil M., & Gowthamarajan, K., (2020). Advancements in Regulatory Framework For Medical Device Regulations In India. *International Journal of Pharmaceutical Research.* 1(1), 745-755. Retrieved from https://www.researchgate.net/publication/343738548_Advancements_in_Regulatory_Framework_For_Medical_Device_Regulations_In_India

BioSpectrumindia Looking at reasons for the high growth of the medical devices industry (2020). Retrieved October 4, 2022, from https://www.biospectrumindia.com/views/59/17367/looking-at-reasons-for-high-growth-of-medical-devices-industry.html

Manu, A., Manas, M., (2021). A review of medical device regulations in India, comparison with European Union and way-ahead. *National Library of Medicine* 13(1), 3–11, Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8815674/

Sethi, R., Rohin, S., & Popli, H., (2017). Medical Devices Regulation in the United States of America, European Union and India: A Comparative Study. *Pharm Regul Aff.* 6(1), 179-183 https://doi.org/10.4172/2167-7689.1000179

Daigle, B., & Torsekar, M., (2019). The EU Medical Device Regulation and the U.S. Medical Device Industry.*Journal of International Commerce and Economics*. 1-22 ,Retrieved from https://www.usitc.gov/publications/332/journals/eu_medical_device_regulation_us_medical_device_industry.pdf

Draft National Medical Device Policy, Association of Indian Medical Device Industry. (2017). Retrieved from https://aimedindia.com/comments-activities/details?k=national-medical-device-policy2017-1436977100

Data from the Ministry of Commerce, compiled by the Association of Indian Manufacturers of Medical Devices, Import of medical devices up by a record ,biospectrumindia. (2019) Retrieved from https://www.biospectrumindia.com/reports-white-papers/59/14035/import-of-medical-devices-up-by-record-24.html

Cybersecurity, USFDA (2022). Retrieved from https://www.fda.gov/medical-devices/digital-health-center-excellence/cybersecurity

CHITKARA

Journal of Pharmaceutical Technology, Research and Management

Chitkara University, Saraswati Kendra, SCO 160-161, Sector 9-C, Chandigarh, 160009, India

Volume 10, Issue 2 **November 2022** **ISSN 2321-2217**