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To Identify Drug-Drug Interaction in Cardiac Patients in Tertiary Care Hospitals

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ABSTRACT

The potential for drug-drug interactions (pDDIs) is higher with cardiac medications, and reports of pDDIs in cardiovascular patients are more common. Multimorbidity, a greater number of drugs prescribed, longer hospital stays, complexity of disease, physiological changes with advancing age or conditions like renal failure, shock, hepatic disease like cirrhosis or acute viral hepatitis, stages of disease, and the influence of heart disease on drug metabolism make patients with CVD especially susceptible to DDIs. Our research found that pDDIs occurred at a much higher rate than expected in the Cardiology Division. Incidence of pDDIs was observed to rise with age, polypharmacy, and duration of hospital stay; pDDIs were also more common in males than females. Most of the interactions were of a pharmacodynamic character and were considered to be quite serious. Most pDDIs involved aspirin and clopidogrel, then aspirin and enalapril, and finally enalapril and enalapril. The surveillance of pDDIs in cardiac inpatients may benefit from the creation of such a database in hospitals.

***Keywords*-** Drug, Drug interaction, Patients Care, Cardiac disease, Case reports.

I. INTRODUCTION

All developed and developing countries are affected by cardiovascular disease (CVD), making it the top cause of mortality worldwide. In 2022, cardiovascular disease was responsible for approximately 18 million deaths, or 41% of all deaths globally. Of these deaths, 95% were caused by cardiovascular events like heart attacks and strokes. The number of deaths is expected to rise to more than 28.6 million by 2050[1,2]. One in four fatalities in India are attributable to cardiovascular disease, and its prevalence is projected to reach 54.5 million by 2020[3,4].

Potential drug-drug interactions (pDDIs) are more commonly documented in cardiovascular patients, and cardiac medications are seen to have a higher potential for interactions.[5,6.] Multimorbidity, greater numbers of drugs prescribed (polypharmacy), longer

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hospital stays, disease complexity, physiological changes with age, and conditions like renal failure, shock, hepatic disease like cirrhosis or acute viral hepatitis, disease stages, and the influence of heart disease on drug metabolism make patients with CVD more susceptible to DDIs. The term "drug-drug interaction" refers to the modification of an effect of one drug (the "object drug") by the concurrent administration of another medication (the "precipitant drug"), and is used in the context of dosages between 7 and 12. (DDI). Potential drug-drug interaction (pDDI) occurs when two medications given at the same time may interact with one another but may not have any noticeable side effects[7-10]. However, DDI is present if the patient exhibits any clinical signs despite the concomitant use of drugs (aDDI). These interactions are sometimes known as adverse medication responses or drug reactions since they might have unfavourable effects on patients (ADIs)[11-13]. Evidence from a variety of research shows that bleeding symptoms caused by DDIs are cause for worry, and that DDIs may increase the likelihood of hospitalisation and subsequent healthcare expenses.[15-17]. Recent international research placed the DDI incidence between 22.3 to 98 percent[18-20]. In spite of the numerous global studies that have evaluated DDIs in CVD patients, published pDDI rates vary widely. As such, the current study is conducted to catalogue the pDDIs and aDDIs among CVD patients at a tertiary hospital in South India, evaluate the causality of aDDIs, and catalogue the risk variables related with pDDIs.

II. MATERIALS AND METHODS

Study design:

•It is a prospective observational study

Study site:

•The research work was conducted Doon Hospital, Dehradun.

Study period:

•6 Months

Inclusion criteria:

•Hospitalized cardiac patients

•Age groups above 18 years.

•Prescriptions with two or more drugs prescribed during the hospitalization wereonly selected for the study.

Exclusion criteria:

•Out patients.

•Ayurveda, siddha, and other prescriptions involving alternative system ofmedicine.

•Age group less than 18 years.

•Prescription with less than 2 drugs prescribed

Source of data:

The information was gathered through interviews with cardiac patients and review of their case records.

Work Methodology

Data was gathered through patient interviews in the cardiac unit and through hospital case records. Patient demographics (age and sex), hospitalisation duration, primary diagnosis, medications used, and comorbidity characteristics were collected from medical records. The Drug Interactions Checker in Micromedex®-2.7 and www.drugs.com were used to identify potential pDDIs in all prescription medications, including those used on a regular basis and those taken pro-re-nata (as needed). Crosschecking manually for sufficient published medical evidence for the identified interacting marketers, the observed pDDIs were categorised as significant, moderate, and small according on the severity of their clinical importance. The DDIs had been identified and categorised in accordance with Micromedex®-2.7 and www.drugs.com based on the profile of medications given.

Pharmaceutical dosage forms and their intermediates (pDDIs) have been classified according to their pharmacokinetic properties (i.e., their ability to be absorbed, distributed, metabolised, and excreted). Comparison of antagonism, synergism, and additive effects in pharmacodynamics. Based on their potential for harm, pDDIs were classified as either: important Because the repercussions might be fatal or permanently debilitating. There is a risk that patients' scientific reputations will suffer as a result of the results, and they may also require more medical attention or a longer hospital stay. Moderate Generally, the repercussions are rather mild. The side effects may be irritating or inconsequential, but they can no longer be allowed to compromise the healing process. Sex, diagnosis, number of medications distributed, frequency of pDDIs, medicines involved in pDDIs, length of hospital stay, pDDI kinds, and pDDI severity were all summarised using frequencies stated as possibilities.

Table 1: Drug-drug interaction distribution in cardiology

Class	Overall number of patients collecting	Overall numberof cases with Dose – Dose Collection	Overall number of drug-drug interaction
Cardiology	463	456 (84.70%)	919

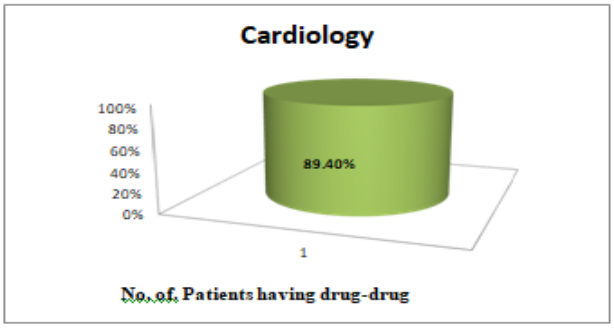

Figure1: Patient Population with Drug Interactions

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Table 2: Patterns of medication interactions by gender

Sex	Frequency (n = 360)	Percentage (%)
Male	240	65.00%
Female	165	35.00%

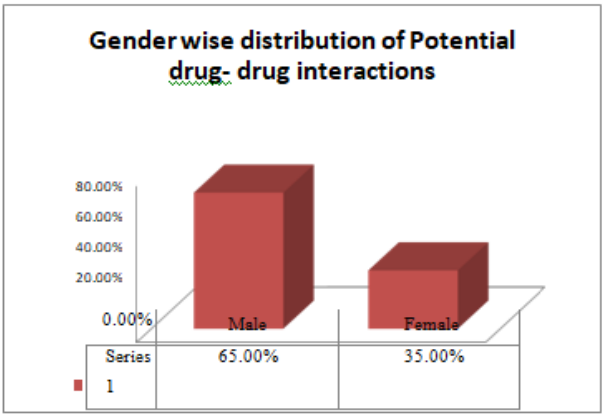

Figure 2: Possible medication interactions, broken down by gender

Table 3: Compare by Age

Age (In yrs)	Frequency (n=360)	Percentage (%)
18-30	11	03.05%
31-45	39	10.83%
46-59	94	26.11%
60-70	159	44.16%
Above 70	57	15.83%

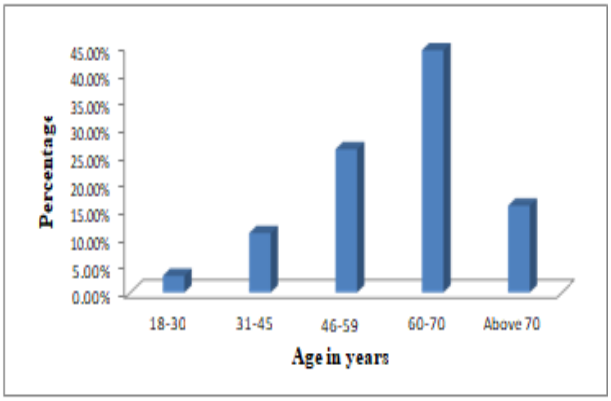

Figure 3: Age wise distribution

Table 4: Quantity of hospitalizations

No. of Hospital Stay (in days)	Frequency (n=360)	Percentage (%)
<3	78	16.55%
4 – 6	264	65.72%
<7	28	9.61%

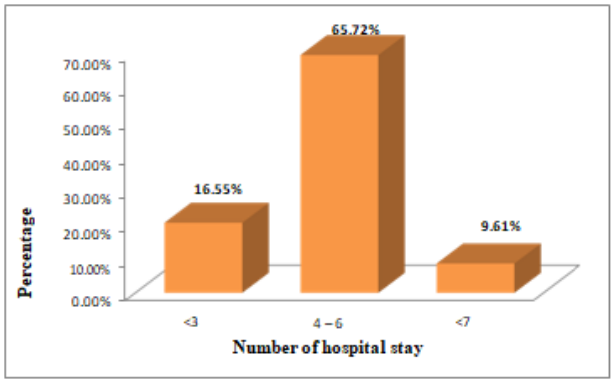

Figure 4: Quantity of hospitalizations

Table 5: Daily doses of prescription medications

Number of drugs prescribed/day	Frequency (n=360)	Percentage%
<4	34	10.05%
5-6	155	38.27%
>7	190	52.66%

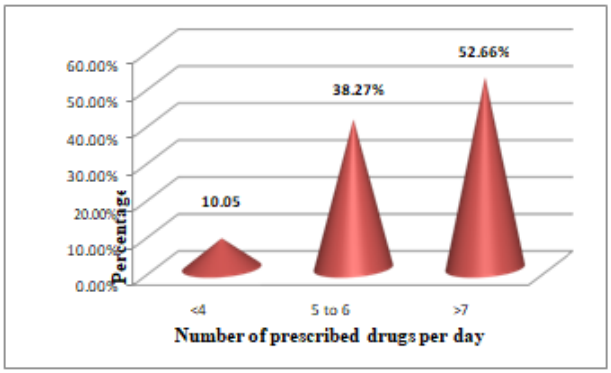

Figure 5: Number of prescribed drugs per day

Table 6: Disease prevalence in the cardiology clinic

Type of diseases	Frequency (n=360)	Percentage%
Myocardial Infarction	57	14.83%
Angina + Diabetes mellitus	91	27.27%
Hypertension	131	32.38%
Ischaemic Heart Disease	36	9.00%
Coronary Artery Disease	24	5.66%
Chronic Heart Failure	21	4.83%

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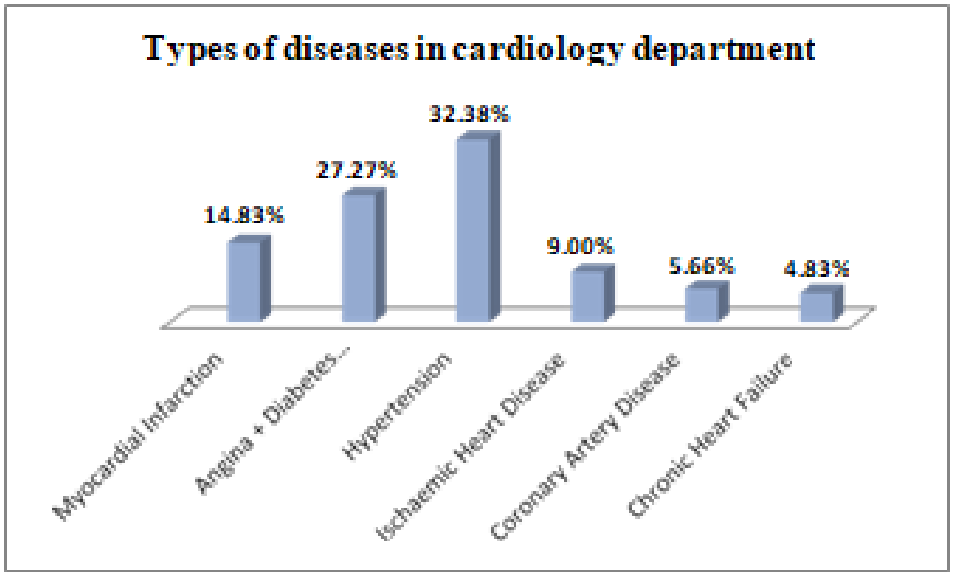

Figure 6: Types of diseases in cardiology department

Table 7: Maximum risk of medication interactions

PDDI Combination	Type	Severity	Frequency (n=850)	Percentage (%)
T.Asprin + T.Clopidogrel	PD	Major	245	28.82%
T.Aspirin + T.Enalapril	PD	Moderate	69	8.11%
T.Atorvastatin +T.Clopidogrel	PK	Moderate	78	9.17%
T.Aspirin + T.Atenolol	PD	Moderate	29	2.94%
T.Clopidogrel +T.Amlodipine	PK	Moderate	80	9.41%
T.Atenolol + T.Metformin	PK	Major	25	2.94%
T.Spironolactone +T.Enalapril	PD	Moderate	18	2.11%
T.Enalapril + T.Metformin	Unknown	Major	15	1.76%
T.Enalapril + T.Furosemide	PD	Moderate	12	1.41%
T.Aspirin + T.Spironolactone	PD	Major	41	4.82%

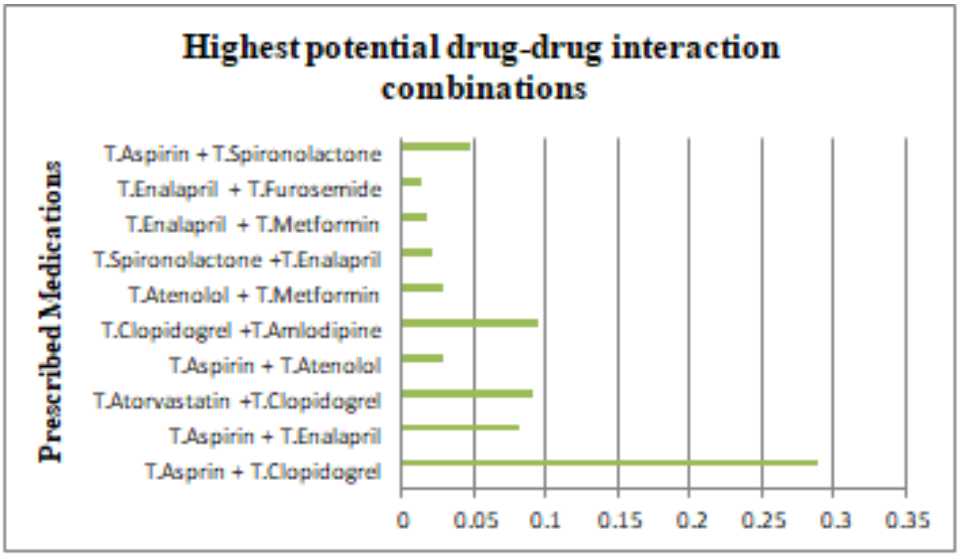

Fig 7: Maximum risk of medication interactions

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III. CONCLUSION

Our research found that pDDIs occurred at a much higher rate than expected in the Cardiology Division. Incidence of pDDIs was observed to rise with age, polypharmacy, and duration of hospital stay; pDDIs were also more common in males than females. Most of the interactions were of a pharmacodynamic character and were considered to be quite serious. Most pDDIs involved aspirin and clopidogrel, then aspirin and enalapril, and finally enalapril and enalapril. The surveillance of pDDIs in cardiac inpatients may benefit from the creation of such a database in hospitals. Although admonitory guidelines and computer-based screening may assist prevent potentially hazardous medication interactions, clinicians should be aware of interactions among these drugs before giving them to patients and comprehensive monitoring should be necessary to ensure patient safety.

REFERENCES

[1] Salvi F., Marchetti A., D'Angelo F., Boemi M., Lattanzio F., Cherubini A. Adverse Drug Events as a Cause of Hospitalization in Older Adults. *Drug Saf.* 2012;35:29–45. doi: 10.1007/BF03319101.

[2] Jönsson A.K., Hakkarainen K.M., Spigset O., Druid H., Hiselius A., Hägg S. Preventable drug related mortality in a Swedish population. *Pharmacoepidemiol. Drug Saf.* 2009;19:211–215. doi: 10.1002/pds.1890.

[3] Lazarou J., Pomeranz B.H., Corey P.N. Incidence of Adverse Drug Reactions in Hospitalized Patients: A Meta-Analysis of Prospective Studies. *Surv. Anesthesiol.* 1999;43:53–54. doi: 10.1097/00132586-199902000-00059.

[4] Jönsson A.K., Spigset O., Tjäderborn M., Druid H., Hägg S. Fatal drug poisonings in a Swedish general population. *BMC Clin. Pharmacol.* 2009;9:7. doi: 10.1186/1472-6904-9-7.

[5] KUMAR, R., SAHA, P., SARKAR, S., RAWAT, N., & PRAKASH, A. (2021). A REVIEW ON NOVEL DRUG DELIVERY SYSTEM. *IJRAR-International Journal of Research and Analytical Reviews (IJRAR)*, *8*(1), 183-199.

[6] Kumar, R., Saha, P., Pathak, P., Mukherjee, R., Kumar, A., & Arya, R. K. EVOLUTION OF TOLBUTAMIDE IN THE TREATMENT OF DIABETES MELLITUS. *Jour. of Med. P'ceutical & Alli. Sci*, *9*.

[7] Nyarko, R. O., Boateng, E., Kahwa, I., & Boateng, P. O. (2020). A comparison analysis on remdesivir, favipiravir, hydroxychloroquine, chloroquine and azithromycin in the treatment of corona virus disease 2019 (COVID-19)-A Review. *World J. Pharm. Pharm. Sci*, *9*, 121-133.

[8] KUMAR, R., SAHA, P., SARKAR, S., RAWAT, N., & PRAKASH, A. (2021). A REVIEW ON NOVEL DRUG DELIVERY SYSTEM. *IJRAR-International Journal of Research and Analytical Reviews (IJRAR)*, *8*(1), 183-199.

[9] Kumar, R., Saha, P., Pathak, P., Mukherjee, R., Kumar, A., & Arya, R. K. EVOLUTION OF TOLBUTAMIDE IN THE TREATMENT OF DIABETES MELLITUS. *Jour. of Med. P'ceutical & Alli. Sci*, *9*.

[10] Nyarko, R. O., Boateng, E., Kahwa, I., & Boateng, P. O. (2020). A comparison analysis on remdesivir, favipiravir, hydroxychloroquine, chloroquine and azithromycin in the treatment of corona virus disease 2019 (COVID-19)-A Review. *World J. Pharm. Pharm. Sci*, *9*, 121-133.

[11] PURABISAHA, R. K., RAWAT, S. S. N., & PRAKASH, A. (2021). A REVIEW ON NOVEL DRUG DELIVERY SYSTEM.

[12] Nyarko, R. O., Kumar, R., Sharma, S., Chourasia, A., Roy, A., & Saha, P. (2022). ANTIBACTERIAL ACTIVITY OF HERBAL PLANT-TINOSPORA CORDIFOLIA AND CATHARNTHUS ROSEUS.

[13] Nyarko, R. O., Saha, P., Kumar, R., Kahwa, I., Boateng, E. A., Boateng, P. O., ... & Bertram, A. (2021). Role of Cytokines and Vaccines in Break through COVID 19 Infections. *Journal of Pharmaceutical Research International*, *33*, 2544-2549.

[14] Sahana, S. (2020). Roshan kumar, Sourav nag, Reshmi paul, Nilayan guha, Indranil Chatterjee. A Review on Alzheimer disease and future prospects. *World Journal of Pharmacy and Pharmaceutical science*, *9*(9), 1276-1285.

[15] Sahana, S., Kumar, R., Nag, S., Paul, R., Chatterjee, I., & Guha, N. (2020). A REVIEW ON ALZHEIMER DISEASE AND FUTURE PROSPECTS.

[16] Saha, P., Kumar, R., Nyarko, R. O., Kahwa, I., & Owusu, P. (2021). HERBAL SECONDARY METABOLITE FOR GASTRO-PROTECTIVE ULCER ACTIVITY WITH API STRUCTURES.

[17] Kumar, R., & Dubey, A. PHYTOCHEMICAL INVESTICATION AND HEPTOPROTECTIVE EVALUTION ACACIA RUBICA EXTRACT ISONIZED AND PARACETAMOL INDUSED ANIMAL TOXICITY. *Turkish Journal of Physiotherapy and Rehabilitation*, *32*(3).

[18] Singh, M. K., Kumar, A., Kumar, R., Kumar, P. S., Selvakumar, P., & Chourasia, A. (2022). Effects of Repeated Deep Frying on Refractive Index and Peroxide Value of Selected Vegetable Oils. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(3), 28-31.

[19] Raj, A., Tyagi, S., Kumar, R., Dubey, A., & Hourasia, A. C. (2021). Effect of isoproterenol and thyroxine in herbal drug used as cardiac hypertrophy. *Journal of Cardiovascular Disease Research*, 204-217.

[20] Nyarko, R. O., Prakash, A., Kumar, N., Saha, P., & Kumar, R. (2021). Tuberculosis a globalized disease. *Asian Journal of Pharmaceutical Research and Development*, *9*(1), 198-201.

ISSN: 2583-4053

Volume-1 Issue-3 || August 2022 || PP. 146-152

https://doi.org/10.55544/jrasb.1.3.20

[21] Bind, A., Das, S., Singh, V. D., Kumar, R., Chourasia, A., & Saha, P. Natural Bioactives For The Potential Management Of Gastric Ulceration. *Turkish Journal of Physiotherapy and Rehabilitation*, *32*(3).

[22] Bind, A., Das, S., Singh, V. D., Kumar, R., Chourasia, A., & Saha, P. Natural Bioactives For The Potential Management Of Gastric Ulceration. *Turkish Journal of Physiotherapy and Rehabilitation*, *32*(3).

[23] Sahana, S. (2020). Purabi saha, Roshan kumar, Pradipta das, Indranil Chatterjee, Prasit Roy, Sk Abdur Rahamat. *A Review of the 2019 Corona virus (COVID-19) World Journal of Pharmacy and Pharmaceutical science*, *9*(9), 2367-2381.

[24] Dubey, A., Yadav, P., Verma, P., & Kumar, R. (2022). Investigation of Proapoptotic Potential of Ipomoea carnea Leaf Extract on Breast Cancer Cell Line. *Journal of Drug Delivery and Therapeutics*, *12*(1), 51-55.

[25] Roshan, K. (2020). Priya damwani, Shivam kumar, Adarsh suman, Suthar Usha. An overview on health benefits and risk factor associated with coffee. *International Journal Research and Analytical Review*, *7*(2), 237-249.

[26] Kumar, R., Saha, P., Lokare, P., Datta, K., Selvakumar, P., & Chourasia, A. (2022). A Systemic Review of Ocimum sanctum (Tulsi): Morphological Characteristics, Phytoconstituents and Therapeutic Applications. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(2), 221-226.

[27] Umama, Y., Venkatajah, G., Shourabh, R., Kumar, R., Verma, A., Kumar, A., & Gayoor, M. K. (2019). Topic-The scenario of pharmaceuticals and development of microwave as; sisted extraction technique. *World J Pharm Pharm Sci*, *8*(7), 1260-1271.

[28] Awuchi, C. G., Amagwula, I. O., Priya, P., Kumar, R., Yezdani, U., & Khan, M. G. (2020). Aflatoxins in foods and feeds: A review on health implications, detection, and control. *Bull. Environ. Pharmacol. Life Sci*, *9*, 149-155.

[29] Kumar, S., Keshamma, E., Trivedi, U., Janjua, D., Shaw, P., Kumar, R., ... & Saha, P. (2022). A Meta Analysis of Different Herbs (Leaves, Roots, Stems) Used in Treatment of Cancer Cells. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 92-101.

[30] Nyarko, R. O., Boateng, E., Kahwa, I., Boateng, P. O., & Asare, B. (2020). The impact on public health and economy using lockdown as a tool against COVID-19 pandemic in Africa: a perspective. *J Epidemiol Public Health Rev*, *5*(3).

[31] Saha, P. (2020). EVOLUTION OF TOLBUTAMIDE IN THE TREATMENT OF DIABETES MELLITUS. *Diabetes*, *2*, 10.

[32] Nyarko, R. O., Kumar, R., Sharma, S., & Chourasia, A. (2022). Ayushmann Roy, and Purabi Saha.". *Antibacterial Activity Of Herbal Plant-Tinospora Cordifolia And Catharnthus Roseus*.

[33] ZAIDI, S., MEHRA, R., & TYAGI, D. S. ROSHAN KUMAR ANUBHAV DUBEY.(2021). Effect of Kalahari Cactus Extract on Appetitte, Body Weight And Lipid Profile In Cafeteria Diet Induced Obesity In Experimental Animal. *Annals of the Romanian Society for Cell Biology*, *25*(6), 13976-13987.

[34] Nyarko, R. O., Awuchi, C. G., Kumar, R., Boateng, E., Kahwa, I., Boateng, P. O., ... & Saha, P. (2022). Evaluation of Cafeteria Diet in Experimental Animal with Plant Extract of Calotropis procera for Obesity Parameter. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 107-113.

[35] Kumar, S., Keshamma, E., Trivedi, U., Janjua, D., Shaw, P., Kumar, R., ... & Saha, P. (2022). A Meta Analysis of Different Herbs (Leaves, Roots, Stems) Used in Treatment of Cancer Cells. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 92-101.

[36] Pandey, M., Singh, A., Agnihotri, N., Kumar, R., Saha, P., Pandey, R. P., & Kumar, A. (2022). Clinical Pharmacology & Therapeutic uses of Diuretic Agents: A Review. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 11-20.

[37] Kumar, R., Saha, P., Keshamma, E., Sachitanadam, P., & Subramanian, M. (2022). Docking Studies of Some Novel Hetrocyclic Compound as Acat Inhibitors: A Meta Analysis. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 33-41.

[38] Amle, V. S., Rathod, D. A., Keshamma, E., Kumar, V., Kumar, R., & Saha, P. (2022). Bioactive Herbal Medicine Use for Eye Sight: A Meta Analysis. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 42-50.

[39] Nyarko, R. O., Roopini, R., Raviteja, V., Awuchi, C. G., Kumar, R., Faller, E. M., ... & Saha, P. (2022). Novel Sars-CoV-2 Variants & Therapeutic Effects. *Journal for Research in Applied Sciences and Biotechnology*, *1*(2), 25-34.

[40] Singh, Y., Paswan, S. K., Kumar, R., Otia, M. K., Acharya, S., Kumar, D., & Keshamma, E. (2022). Plant & Its Derivative Shows Therapeutic Activity on Neuroprotective Effect. *Journal for Research in Applied Sciences and Biotechnology*, *1*(2), 10-24.

[41] Kumar, S., Yadav, S. P., Chandra, G., Sahu, D. S., Kumar, R., Maurya, P. S., ... & Ranjan, K. (2019). Effect of dietary supplementation of yeast (Saccharomyces cerevisiae) on performance and hemato-biochemical status of broilers.

[42] Dubey, A., Kumar, N., Mishra, A., Singh, Y., & Tiwari, M. (2020). Review on Vinpocetine. *International Journal of Pharmacy & Life Sciences*, *11*(5).

[43] Kumar, R., Keshamma, E., Paswan, S. K., Saha, P., Trivedi, U., Chourasia, A., & Otia, M. (2022). Alkaloid Based Chemical Constituents of Ocimum santum & Cinchona Bark: A Meta Analysis. *Journal for Research in Applied Sciences and Biotechnology*, *1*(2), 35-42.

[44] Anubhav, S. P. D., Sanjay, K. D., & Roshan, K. (2022). Evaluation of Enzyme Producing K. Pneumoniae and Their Susceptibility to Other Anti-Biotics. *International Journal of Innovative Science and*

ISSN: 2583-4053

Volume-1 Issue-3 || August 2022 || PP. 146-152

https://doi.org/10.55544/jrasb.1.3.20

Research Technology, *7*(5), 351-353.

[45] Bugga, P., Alam, M. J., Kumar, R., Pal, S., Chattopadyay, N., & Banerjee, S. K. (2022). Sirt3 ameliorates mitochondrial dysfunction and oxidative stress through regulating mitochondrial biogenesis and dynamics in cardiomyoblast. *Cellular Signalling*, *94*, 110309.

[46] Saha, P., Kumar, A., Bhanja, J., Shaik, R., Kawale, A. L., & Kumar, R. (2022). A Review of Immune Blockade Safety and Antitumor Activity of Dostarlimab Therapy in Endometrial Cancer. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(3), 201-209.

[47] Kumar, N., Dubey, A., Mishra, A., & Tiwari, P. (2020). Ethosomes: A Novel Approach in Transdermal Drug Delivery System. *International Journal of Pharmacy & Life Sciences*, *11*(5).

[48] Bhati, V., Yadav, P. K., & Kumar, R. (2018). Effect of Levels of Inorganic Fertilizers, Organic Manure and Bio-Fertilizers on Plant Growth Attributes of Onion (Allium cepa L.) cv. N-53 under Hot Arid Region of Western Rajasthan, India. *International J. Curr. Micro. Appl. Sci*, *7*, 3593-601.

[49] Nalimu, F., Oloro, J., Kahwa, I., & Ogwang, P. E. (2021). Review on the phytochemistry and toxicological profiles of Aloe vera and Aloe ferox. *Future Journal of Pharmaceutical Sciences*, *7*(1), 1-21.

[50] SHAFQAT ZAIDI, R. K., MEHRA, D., & ROSHAN, K. A. D. (2021). Effect of Kalahari Cactus Extract on Appetitte, Body Weight And Lipid Profile In Cafeteria Diet Induced Obesity In Experimental Animal. *Annals of the Romanian Society for Cell Biology*, *25*(6), 13976-13987.

[51] Mukkamala, R., Kumar, R., Banerjee, S. K., & Aidhen, I. S. (2020). Synthesis of Benzyl C-Analogues of Dapagliflozin as Potential SGLT2 Inhibitors. *European Journal of Organic Chemistry*, *2020*(12), 1828-1839.

[52] Kumar, R., & Saha, P. (2022). A Review on Artificial Intelligence and Machine Learning to Improve Cancer Management and Drug Discovery. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(3), 149-156.

[53] Kumar, R., Jain, A., Tripathi, A. K., & Tyagi, S. (2021, January). Covid-19 outbreak: An epidemic analysis using time series prediction model. In *2021 11th international conference on cloud computing, data science & engineering (Confluence)* (pp. 1090-1094). IEEE.

[54] KUMAR, A. (2019). The Scenario of Pharmaceuticals and Development of Microwave Assisted Extraction Techniques.

[55] Saha, P., Nyarko, R. O., Lokare, P., Kahwa, I., Boateng, P. O., & Asum, C. (2022). Effect of Covid-19 in Management of Lung Cancer Disease: A Review. *Asian Journal of Pharmaceutical Research and Development*, *10*(3), 58-64.

[56] Daharia, A., Jaiswal, V. K., Royal, K. P., Sharma, H., Joginath, A. K., Kumar, R., & Saha, P. (2022). A Comparative review on ginger and garlic with their pharmacological Action. *Asian Journal of Pharmaceutical Research and Development*, *10*(3), 65-69.

[57] Kumar, R., Saha, P., Kumar, Y., Sahana, S., Dubey, A., & Prakash, O. (2020). A Review on Diabetes Mellitus: Type1 & Type2. *World Journal of Pharmacy and Pharmaceutical Sciences*, *9*(10), 838-850.

[58] Westerlund T., Gelin U., Pettersson E., Skärlund F., Wågström K., Ringbom C. A retrospective analysis of drug-related problems documented in a national database. *Int. J. Clin. Pharm.* 2012;35:202–209. doi: 10.1007/s11096-012-9724-1

[59] Sjöqvist F., Böttiger Y. Historical perspectives: Drug interactions—It all began with cheese. *J. Intern. Med.* 2010;268:512–515. doi: 10.1111/j.1365-2796.2010.02300.x.

[60] Askari M., Eslami S., Louws M., Wierenga P.C., Dongelmans D.A., Kuiper R.A., Abu-Hanna A. Frequency and nature of drug-drug interactions in the intensive care unit. *Pharmacoepidemiol. Drug Saf.* 2013;22:430–437. doi: 10.1002/pds.3415.

[61] de Oliveira L.M., Diel J.A.C., Nunes A., da Silva Dal Pizzol T. Prevalence of drug interactions in hospitalised elderly patients: A systematic review. *Eur. J. Hosp. Pharm.* 2021;28:4–9. doi: 10.1136/ejhpharm-2019-002111.

[62] Remen V.M., Grimsmo A. Closing information gaps with shared electronic patient summaries—How much will it matter? *Int. J. Med. Inform.* 2011;80:775–781. doi: 10.1016/j.ijmedinf.2011.08.008.

[63] Eiermann B., Bastholm Rahmner P., Korkmaz S., Landberg C., Lilja B., Shemeikka T., Veg A., Wettermark B., Gustafsson L.L. Knowledge Bases for Clinical Decision Support in Drug Prescribing–Development, Quality Assurance, Management, Integration, Implementation and Evaluation of Clinical Value. In: Jao C.S., editor. *Decision Support Systems.* InTech; Rijeka, Croatia: 2010. p. 406.

[64] Car J., Tan W.S., Huang Z., Sloot P., Franklin B.D. eHealth in the future of medications management: Personalisation, monitoring and adherence. *BMC Med.* 2017;15:73. doi: 10.1186/s12916-017-0838-0.

[65] Risling T., Martinez J., Young J., Thorp-Froslie N. Evaluating Patient Empowerment in Association with eHealth Technology: Scoping Review. *J. Med. Internet Res.* 2017;19:e329. doi: 10.2196/jmir.7809.